STATISTICAL CONCEPTS IN DESIGN

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ABSTRACT

In seeking a manageable way to deal with variations for a large range of body sizes, it is a common practice for designers to construct drafting board manikins, three-dimensional forms or computer simulations as human analogues. Often these analogues are based upon 5th, 50th or 95th percentile values. Limitations of this approach are discussed in this paper which demonstrate fallacies underlying the assumption that (1) the proportionality of various sized individuals is the same and (2) that percentiles for body dimensions are additive.

Focusing on the 5th and 95th percentile body forms where deviations in size and proportionality are most severe, the report recommends an improved approach to portray the body size of these segments of the population in design problems. A statistical analysis is made of the tails of the height-weight distribution to demonstrate the usefulness of sub-groups or regression values. It is suggested that, for many design purposes, subgroup or regression values be used which would maintain statistical integrity in simulations and, at the same time, portray the ends of the distribution more accurately than is presently done.

PREFACE

This study was conducted under contract AF33615-75-5003 with the Aerospace Medical Research Laboratory, U. S. Air Force, Wright-Patterson Air Force Base, Ohio. Project scientists were Dr. John T. McConville and Edmund Churchill, Anthropology Research Project, Webb Associates. Mr. C. E. Clauser, Crew Station Integration Branch, Aerospace Medical Research Laboratory, acted as contract monitor.

Ms. Ilse Tebbetts and Ms. Jane Reese, Webb Associates, edited and prepared the manuscript for publication.

This technical report has been reviewed and is approved for publication.

APPENDIXES

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (continued)

STATISTICAL CONCEPTS IN DESIGN

Considerable emphasis is placed today on the design of equipment and work stations to accommodate their ultimate users and on considering the functional man as an integrated component in the system design. Despite this focus, problems of how best to design the variations in body size are far from solved.

Among the many design aids used in the development of clothing, personal protective equipment and work stations are various forms of human analogues. These analogues may range from simple two-dimensional templets to elaborate three-dimensional anthropometric dummies and will have in common only that they were developed to characterize in some fashion the size and shape of a specific design population.

Engineering design manikins have been widely used in the field of aviation. As early as 1926, Mr. Hugh Lippman constructed a profile scale manikin which was used as the specification of human body size in military aircraft cockpit design. Captain H. G. Armstrong soon thereafter assembled data on the size of aviation cadets to demonstrate that the current recruiting standards were permitting acceptance of individuals who were over-large for the aircraft then in use. Armstrong recommended that fighter pilots be limited to 70 inches in stature and 180 pounds in weight to gain maximum performance from fighter aircraft. For a period prior to World War II, the fighter pilot's stature was restricted to 68 inches (Randall, et al., 1946).

With the heavy demands for aircrew in World War II, the size requirements were lifted in complete disregard for body size criteria which had been used in the design of the aircraft then in service. The staggering problems that resulted and the work accomplished in their solution by Army Air Force anthropologists have been fully documented by Randall, et al. (1946). Part of this work involved the development of jointed drafting board profile manikins constructed to 1/30th scale (Randall, 1943).

The Army aviator population was represented in three sizes known as types A, B and C, to attempt a functional coverage of the variations in body size. Type A was approximately an average size individual, type B a small individual, and type C a large individual. The average stature and weight of each of the three body size types are shown in Table 1.

TABLE 1

Stature and Weight Design Values of
Army Air Force Manikins

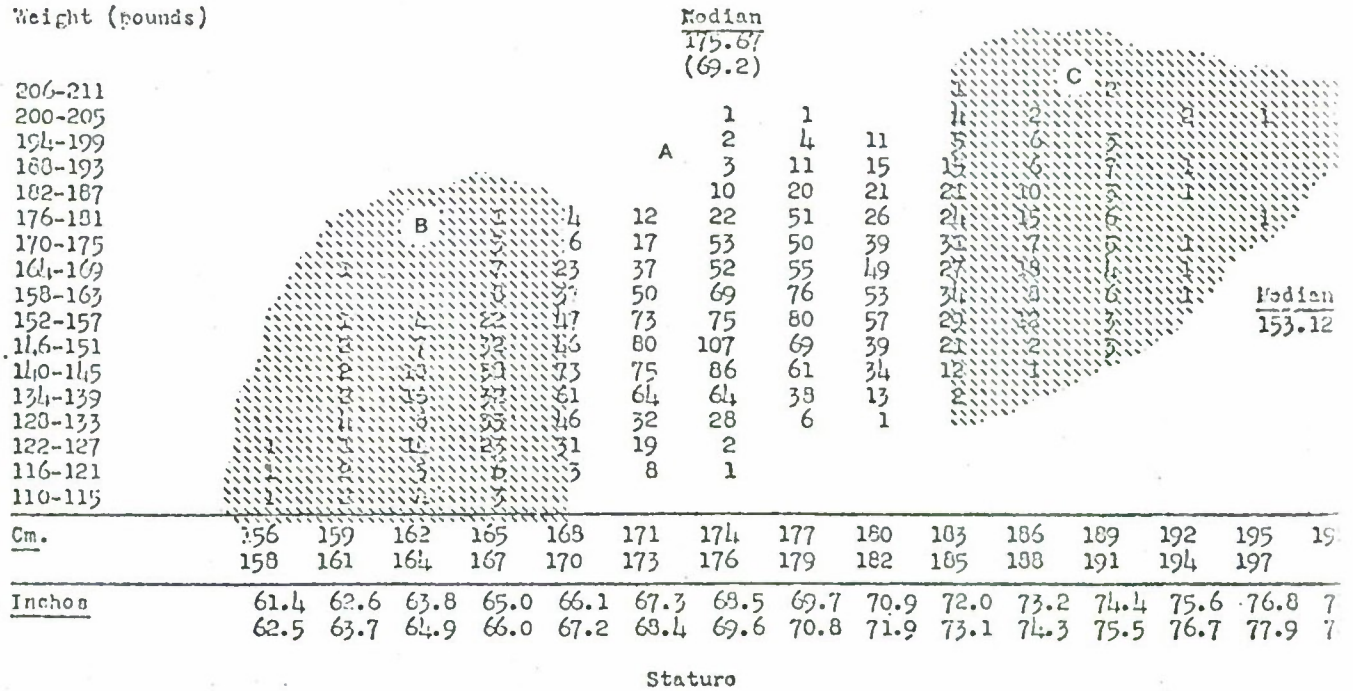
Body Type	Stature	Weight
A	175.3 cm (69.0 in)	154.3 lbs
B	166.5 cm (65.5 in)	140.3 lbs
C	186.3 cm (73.5 in)	171.7 lbs

It was believed that cockpits and other crew stations designed to adequately accommodate this range of stature and weight would accommodate about 90 percent of the aircrews then flying.

The design values used are plotted on a stature-weight bivariate table (Figure 1) for fliers of that era (Randall, et al., 1946, p. 273). Subsamples were selected by dividing the range of body stature into equal thirds and then computing the arithmetic mean for each dimension for the small and large subsets. These mean values become the manikin design values for body types B and C. The mean values for the total sample were then used as the manikin design values for body type A. The two-dimensional drafting board manikins were later supplemented with full scale three-dimensional forms which could be used as test devices in the mock-up stage of the design to test the crew/work station accommodations.

FIGURE 1.

Correlation of Weight With Stature



Drafting board manikins and, to a lesser degree, the full scale body forms have proved to be very useful engineering aids and are in widespread use today. Nevertheless, certain fundamental questions relating to how effectively these design guides characterize the size variance of the design population remain unresolved. It is common to find that a family of drafting manikins is developed for a particular design problem to represent, for example, the 5th, 50th, and 95th percentile body sizes. The wide use of this type of approach warrants an examination of exactly what these manikins portray in terms of body size variance in the population.

A commonly held concept in design revolves about designing for the "average man." The average (arithmetic mean, median or mode) can be computed for any dimension measured and, if the sampling is adequate, is an estimate of central tendency for that variable for the population. When the average is used in conjunction with some measure of variability, such as the standard deviation, it becomes a useful descriptive tool to specify population parameters. Because the average is a measure of the location of central tendency, it appears logical to assume that it must serve some important role in that design.

The use of the average, despite its value as a design datum, can lead to grave consequences. If, for example, the average value of stature is used as the design criterion for clearance of a doorway, it would soon be apparent that approximately half the potential users would not be properly accommodated. Those

individuals having stature greater than average would not have sufficient clearance to clear the door lintel without stooping.

It also appears to be commonly assumed that an average-sized individual will be essentially average in all dimensions. This is a rather common extension of the idea that body proportions are more or less constant, that a small individual is a miniature version of an average sized individual and the larger sized person an expanded version of an average sized individual.

In a study of the concept of the average man, Churchill and Daniels (Daniels, 1952) tested the assumption of what measurement values constitute the average man using ten dimensions useful in clothing design. The average was defined for purposes of the study as any value which fell within the limits of the mean $\pm$ 0.3 of a standard deviation rounded to the nearest whole centimeter. This would mean that approximately 23 to 30 percent of the population would be included as average for any one dimension. Churchill and Daniels found that of the 4063 subjects in the study sample* 1055 were classified, within the limits of their definition, as being of average stature. In the next step, the average range of each of the nine additional selected measures were added with the following results:

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* Data from Hertzberg, et al., 1954.

TABLE 2

The Average Man

Variable	Range Defining Average (cm)	No. Included	Percent of Sample
Stature	173.95 - 177.95	1055	25.97
Chest Circ	96.95 - 100.95	302	7.43
Sleeve Length	83.95 - 86.95	143	3.52
Crotch Height	81.95 - 84.95	73	1.80
Vert Torso Circ	162.95 - 166.95	28	0.69
Hip Circ (S)	103.95 - 108.95	12	0.30
Neck Circ	36.95 - 38.95	6	0.15
Waist Circ	78.95 - 83.95	3	0.07
Thigh Circ	54.95 - 57.95	2	0.05
Crotch Length	69.95 - 72.95	0	----

Thus, of the 1055 men of "average" stature, only 302 were also of average chest circumference and so forth. The investigators concluded that the "average man" can be "a misleading and illusory concept as a basis for design criteria" and suggested that the range of variability in body dimensions is more valid than an "average" value in design solutions (Daniels, 1952, p. 4).

The more sophisticated designer will look beyond the "average" and think in terms of a design concept which incorporates the tails of the distribution of values as well. Ideally, a designer should cover the entire range of variation in a population but in practice this can seldom be achieved successfully. A few individuals on either end of the normal curve often require so many additional sizes and/or range of adjustability in a given item that their inclusion is impractical or uneconomical. In general terms, it is almost impossible to design for more than 90 - 95 percent of the population without compromising the effectiveness of an item of clothing, personal protective equipment, or workplace layou

To illustrate the problem, one might, for example, examine the range of variability for a single dimension to demonstrate the variability associated with various segments of the population distribution. Using the dimension of stature (USAF 1967 anthropometric data), we find the variability in the central half of the distribution between the 25th and 75th percentiles to be approximately 8.4 cm; the range of variability for the central 90 percent is ∿20.4 cm; and the total range of variability, shortest to tallest, is ∿35.5 cm. The increase in variance is not linear with the distribution of subjects as is demonstrated in the following figures (2 and 3) for the dimensions of stature and weight.

FIGURE 2.

STATURE VARIABILITY BY PERCENTILE GROUPS

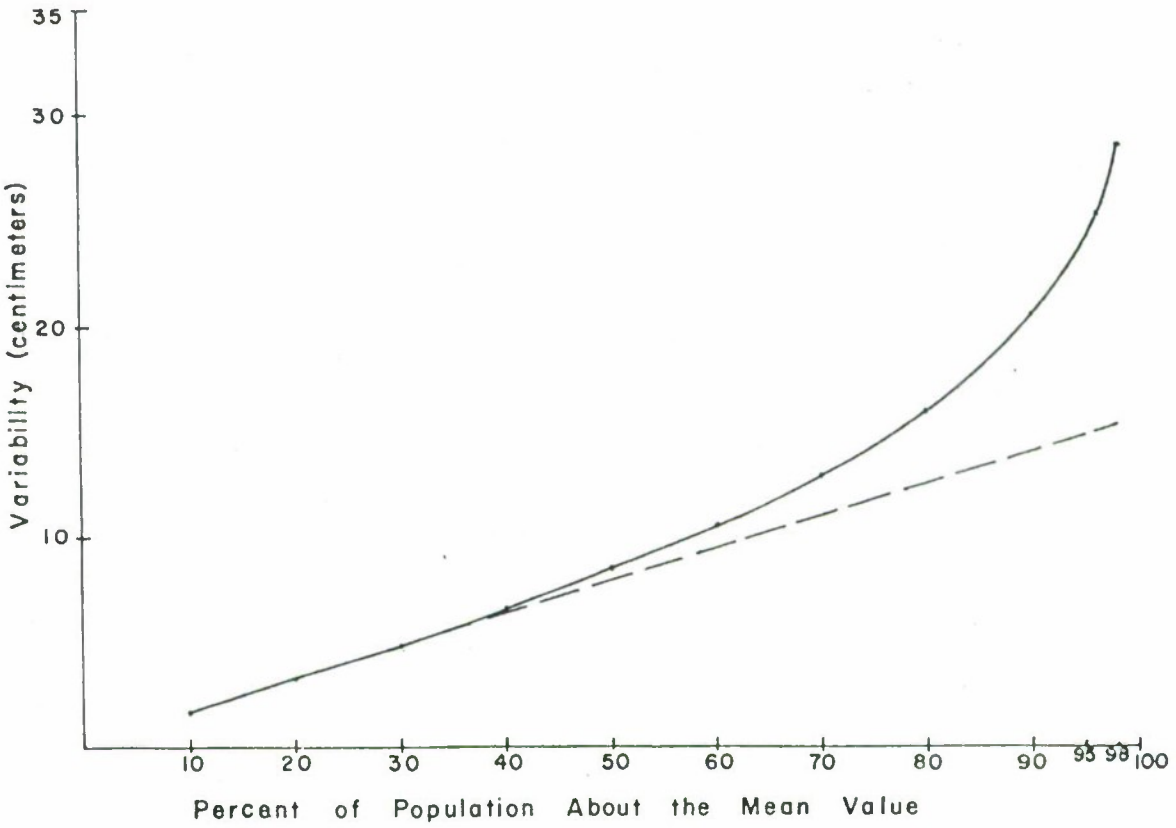
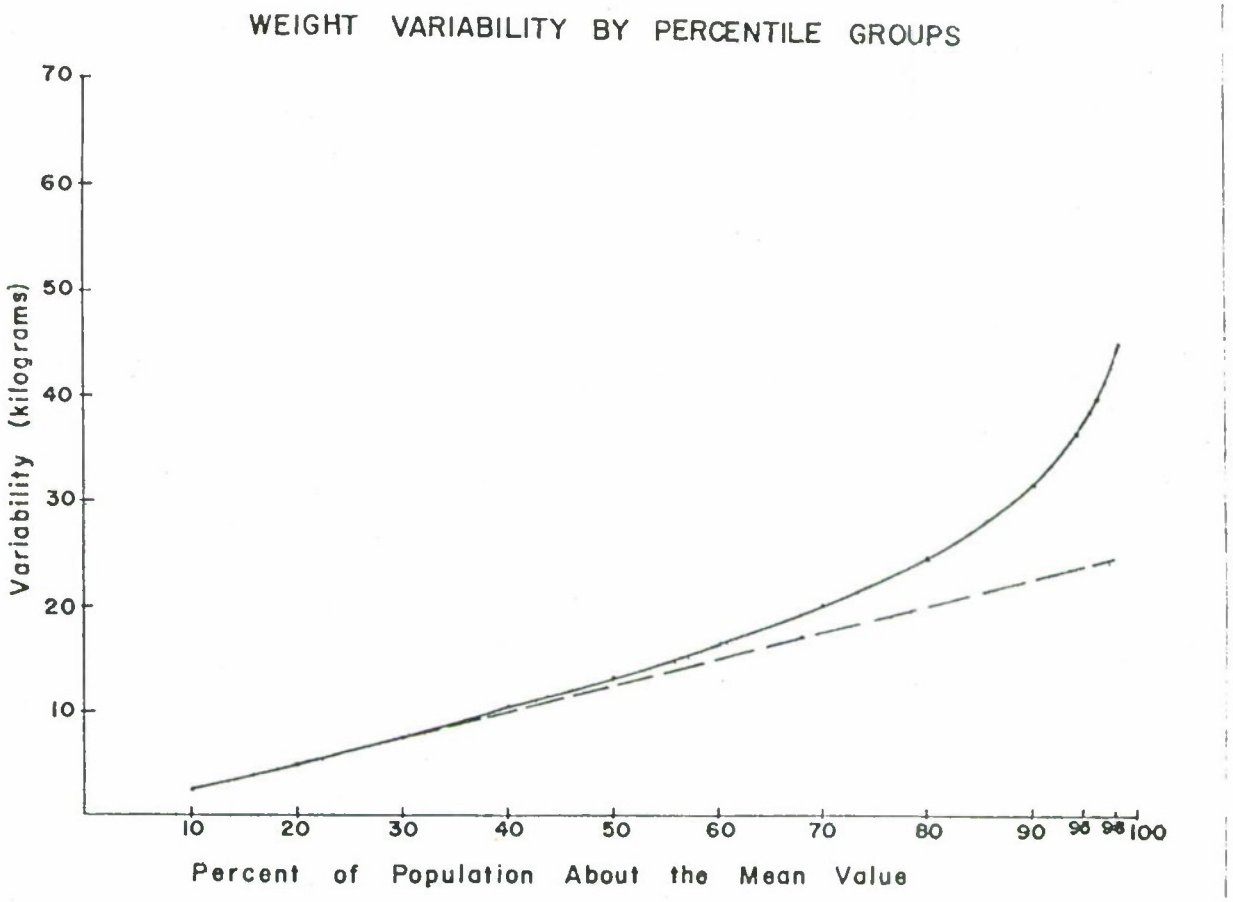


FIGURE 3.



The x axis here denotes the percentage of the population about the mean value; for example, 10 percent signifies the individuals who fall in the distribution between the 45th and 55th percentiles, 20 percent the individuals between the 40th and 60th percentiles, etc. The y axis denotes the variability in centimeters or kilograms of measured stature or weight, respectively, for the specified groups. It is apparent from this line graph that the increase in variance is relatively constant in the middle of the distribution but increases very

rapidly toward the tails of the distribution. The dotted line on the graph represents the variance that would be anticipated based upon the central third of the distribution values. This line graph is quite characteristic of the variance that can be expected in other human body measurements.

As a consequence of this non-linearity, it is general practice to seek a design solution only for that part of the population which constitutes the central 90 to 95 percent of the total and largely disregard the extreme values in the distribution. In fact, it is often found that when a design is successful for the design population, it will also accommodate a portion of the individuals who lie beyond the design limits although seldom, if ever, will such a solution accommodate all potential users without some custom fabrication or modification.

While this concept of design limits is widely held and is, in some ways, extremely useful, it has acquired some unfortunate corollaries. We find, for example, that the 5th and 95th percentile values from the design population have become accepted as the only operating design values for accommodation of the population and the dimensional values have become formulated as the 5th or 95th percentile body form, head form, etc. Designers have then worked to accommodate the size or shape variance in these forms with the rationale that by so doing they would also accommodate in their design all the combinations of size and shape that fall within these limits.

The limitations which apply to the "average man" are, if anything, intensified in dealing with the 5th and 95th percentile

forms. Not only are the percentile forms unrealized in nature, they are also statistically impossible. The problem created by this approach is illustrated in Table 3. To create this table, based on data from Clauser, et al., (1972), we divided the human body into fourteen vertical segments, and obtained the 95th percentiles for each vertical distance. Adding these values together, we get a stature of 202.2 cm (79.6 in.), almost exactly a full foot (30 cm) greater than the 95th percentile for stature and some 19.2 cm larger than the tallest subject measured in the survey sample of 1905 women.

TABLE 3

95th Percentiles--WAF Height Segments

	cm
Floor to lateral malleolus level	7.8
Lateral malleolus level to ankle level	6.8
Ankle level to tibiale level	34.4
Tibiale level to gluteal furrow level	34.8
Gluteal furrow level to crotch level	5.1
Crotch level to buttock level	10.5
Buttock level to trochanteric level	3.9
Trochanteric level to abdominal extension level	13.6
Abdominal extension level to waist level	9.7
Waist level to bustpoint level	21.9
Bustpoint level to acromial level	16.8
Acromial level to suprasternale level	2.4
Suprasternale level to cervicale level	9.4
Cervicale level to vertex	25.1
Total	202.2

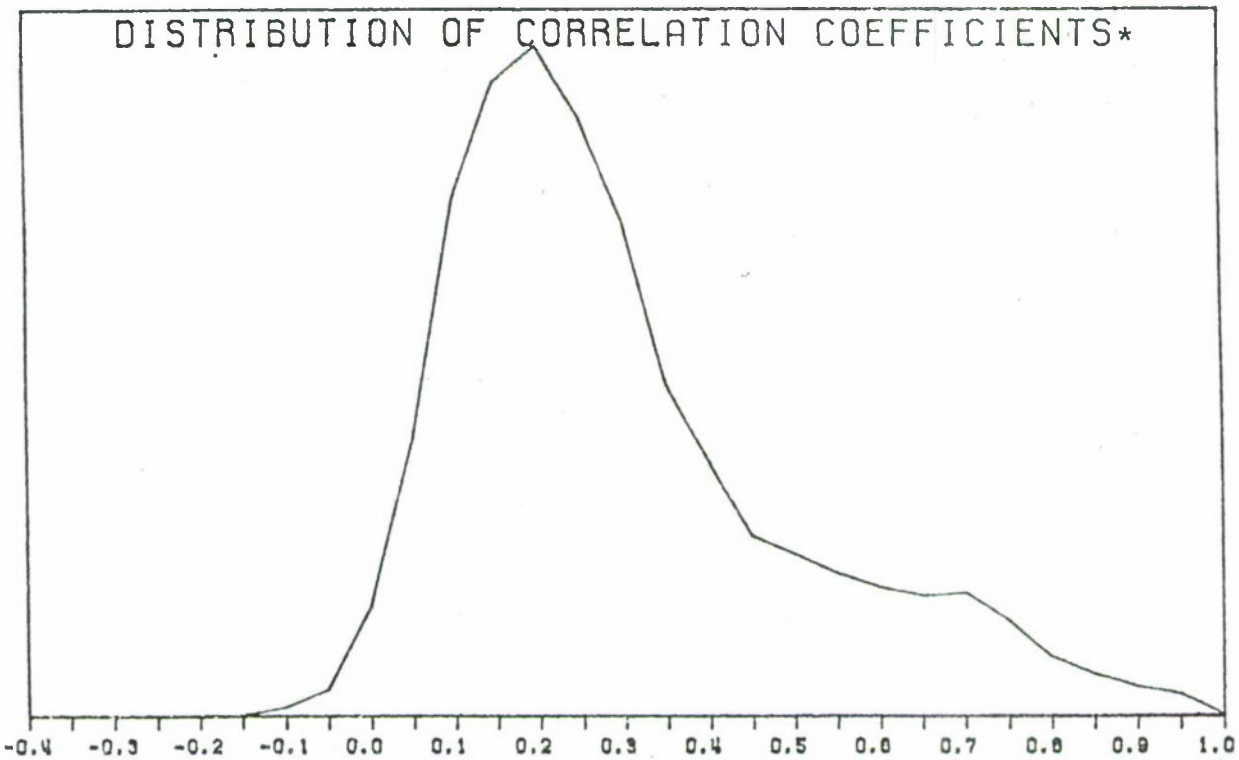
While Table 3 demonstrates only what occurs with linear measurement of the body, it is possible to speculate what the use of all 95th percentile breadths, depths and circumferences would mean in terms of body volume and the resulting weight.

This example raises questions as to how it is possible to have a 5th or 95th percentile anthropometric dummy. The answer is that these forms are a mixture of percentile values, some specified and others let fall as they must, to permit the assembly of a three-dimensional form. The results are often so strikingly unrealistic as to cause serious doubts as to their usefulness (Searle and Haslegrave, 1969, 1970). What happens, of course, is that the designer, in attempting to hold as many of the dummy dimensions as possible to the 95th percentile values, ends up making some compromises. For example, if the stature and sitting height (or torso length) are both held to the 95th percentile values, the leg lengths must of necessity be disproportionately short. Nevertheless, such forms often become established as the 5th or 95th or some other percentile "standard" and are widely used whether or not they are particularly appropriate for a specific design solution.

Before proceeding further, we should attempt to determine exactly what the various simulations are meant to portray. They are, first, design aids or graphic illustrations of numerical or statistical anthropometric data. Their principal value lies in the translation of numbers or tabular data into representative shapes and forms. This particular aspect is also their weakness in that once the data input is selected the form is fixed. If there were a perfect correlation among body dimensions ($r \sim 1.0$), this would not be a problem because it would be possible to scale a single dimension throughout its range and thereby include every conceivable body size. The statistical relationship among body

dimensions is, unfortunately, considerably less than perfect, as illustrated in Figure 4 by the distribution of correlation coefficients from the WAF 1968 anthropometric survey report (Clauser, et al., 1972, p. 247).

FIGURE 4.



* This distribution includes a total of 7626 correlation coefficients.

Secondly, while the average or 50th percentile depicts an optimum design size, the 5th and 95th percentile forms depict a worst possible combination of dimensional values, although neither of these body sizes can be fully realized in actual life nor in three-dimensional forms. In the construction of design manikins, a number of assumptions are made. One such

assumption is that the proportionality of the variously sized individuals (small to large) is essentially the same for all; a second is that small men are small overall and large men essentially large overall. As can be demonstrated in the following analysis, neither of these assumptions is wholly reliable, particularly as they pertain to the tails of the population.

An analysis of selected variables for specific segments of the USAF 1967 and WAF 1968 samples was carried out. In this exercise each sample was broken down by subjects on the basis of 1) stature, and 2) stature and weight. In the first breakout there were three subsets based on the subjects' statures: those with statures below the 10th percentile (the "shorts"); those with statures between the 10th and 90th percentiles (the "regulars"); and those with statures greater than the 90th percentile (the "longs"). The cutoff value, the number in each subset, and its percentage of the total sample are shown below.

		SHORTS			REGULARS			LONGS		
U.S. Air Force		Stature (cm)	No.	%	Stature (cm)	No.	%	Stature (cm)	No.	%
Males	1967	<169.4	234	9.7	169.4-185.4	1917	79.2	>185.4	269	11.1
Females	1968	<154.3	177	9.3	154.3-169.9	1525	80.0	>169.9	204	10.7

For each variable, the mean ($\bar{X}$), standard deviation (SD), and coefficient of variation (V) for each subgroup were prepared, as well as the variable subset mean value expressed as a simple ratio of stature. The ratios for selected variables are shown below in Table 4.

TABLE 4

Subset Mean Values for Selected Variables as a Ratio of Stature

	SHORT		REGULAR		LONG	
	Male	Female	Male	Female	Male	Female
Suprasternale Ht	81.6%	81.1%	81.9%	81.4%	82.2%	81.7%
Buttock Height	50.2	50.2	50.8	50.7	51.3	51.2
Crotch Height	47.4	45.3	48.0	45.9	48.4	46.7
Sitting Height	53.3	53.5	52.6	52.8	51.9	52.1
Midshoulder Ht/Sit	36.7	36.0	36.4	35.8	36.1	35.5
Acromiale-Radiale Lgth	18.5	19.1	18.6	19.1	18.6	19.1
Thumb-tip Reach	45.5	45.9	45.3	45.8	45.3	45.2
Vertical Trunk Circ	96.2	97.0	94.8	95.3	93.8	93.6
Hip Breadth	20.4	22.1	19.9	21.6	19.5	20.9

While ratios were tabulated for only a few selected body dimensions and the "short" and "long" subgroups were numerically small, there are real and significant differences in proportionality among the created subsets. It is relatively clear that the "longs" have a greater proportion of leg length and conversely a shorter proportion of torso length in relation to stature than do the "regulars" and, in a similar fashion, the "regulars" exceed the "shorts." The difference is large enough to be significant. We see, for example, that the sitting height of the male "shorts" is 53.3% of stature, and of the "longs" 51.9%, a difference of only 1.4%. Yet, if the mean stature of the male "regulars" (177.2 cm) is multiplied by the two ratios, we get 94.4 cm and 92.0 cm, a difference of 2.4 cm which could be of significance in a design problem.

The differences among the subgroups for the dimensions of vertical trunk circumference and hip breadth are also relatively large, while those for the dimensions of arm reach (thumb-tip reach) and upper arm length (acromiale-radiale length) are quite small.

In order to look more closely at these variables, the same survey samples were broken into subsets based on the variables "stature" and "weight" with the "small-shorts" consisting of subjects below the 10th percentile for both stature and weight, the "medium-regulars" being subjects from the 10th to the 90th percentiles, and the "large-longs" being the subjects who were greater than the 90th percentile for both variables. The resulting subsets were:

Small-Short		No.	%
Male 1967	<169.4 cm and <146.9 lbs	60	2.5
Female 1968	<154.3 cm and <106.9 lbs	59	3.1

Medium-Regular		No.	%
Male 1967	(All other subjects not	2271	93.8
Female 1968	included in the small-short and large-long subgroups.)	1780	93.4

Large-Long		No.	%
Male 1967	>185.4 cm and >201.8 lbs	89	3.7
Female 1968	>169.9 cm and >147.8 lbs	66	3.5

As in the previous breakout of subsets, we see the extreme categories contain slightly different frequencies than we would expect from a bivariate normal distribution with a correlation coefficient of 0.5.* Presented below (Table 5) are the same nine variables as previously used for these subsets.

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* We would anticipate a frequency of approximately 3.7% based upon an r of 0.5 and a normal bivariate distribution.

TABLE 5

Height-Weight Subset Mean Values for
Selected Variables as a Ratio of Stature

	SHORT		REGULAR		LONG	
	Male	Female	Male	Female	Male	Female
Suprasternale Ht	81.3%	80.9%	81.9%	81.4%	82.4%	81.9%
Buttock Height	49.9	50.1	50.8	50.7	51.4	51.5
Crotch Height	47.4	45.3	48.0	45.9	48.2	46.8
Sitting Height	53.5	53.4	52.5	52.8	52.0	52.2
Midshoulder Ht/Sit	36.4	35.8	36.4	35.8	36.5	35.6
Acromiale-Radiale Lgth	18.3	19.2	18.6	19.1	18.6	19.3
Thumb-tip Reach	45.4	46.0	45.3	45.7	45.4	45.6
Vertical Trunk Circ	93.2	95.0	94.8	95.2	96.1	95.9
Hip Breadth	19.5	21.2	19.9	21.6	20.2	21.8

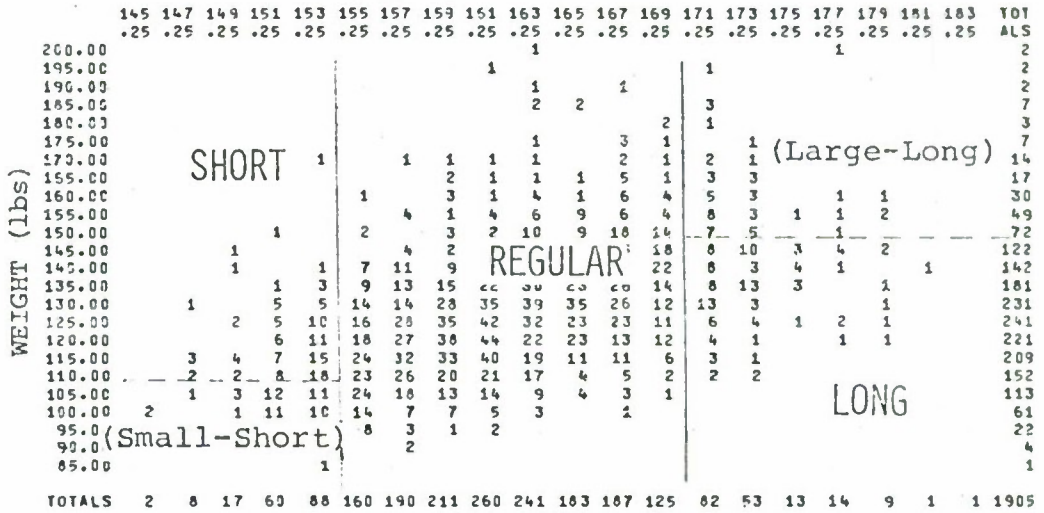
The ratios for the "medium-regular" subset are not essentially different from those shown in Table 4. The values for "small-short" and "large-long" do, however, now show even larger deviations from the proportions of the "medium-regular" subset for the linear dimensions. Referring to Figures 5 and 6 will illustrate, in general, what is taking place. The subsets "small-short" and "large-long" are now at the very extremes of the bivariate table of stature and weight distribution and are not only most dissimilar in body size from the average ("medium-regular") in size but apparently in proportions as well.

If we are critical of the existing anthropometric design concepts, what can we offer as a more valid and useful approach? Toward this end an analysis was undertaken to develop a design concept which would maintain statistical consistency while at the same time portray the two tails of the body size distribution in an accurate and usable fashion.

In Table 6 the mean values for the dimensions of the "small-short" USAF 1967 subgroup, as previously defined, are compared to

FIGURE 5.

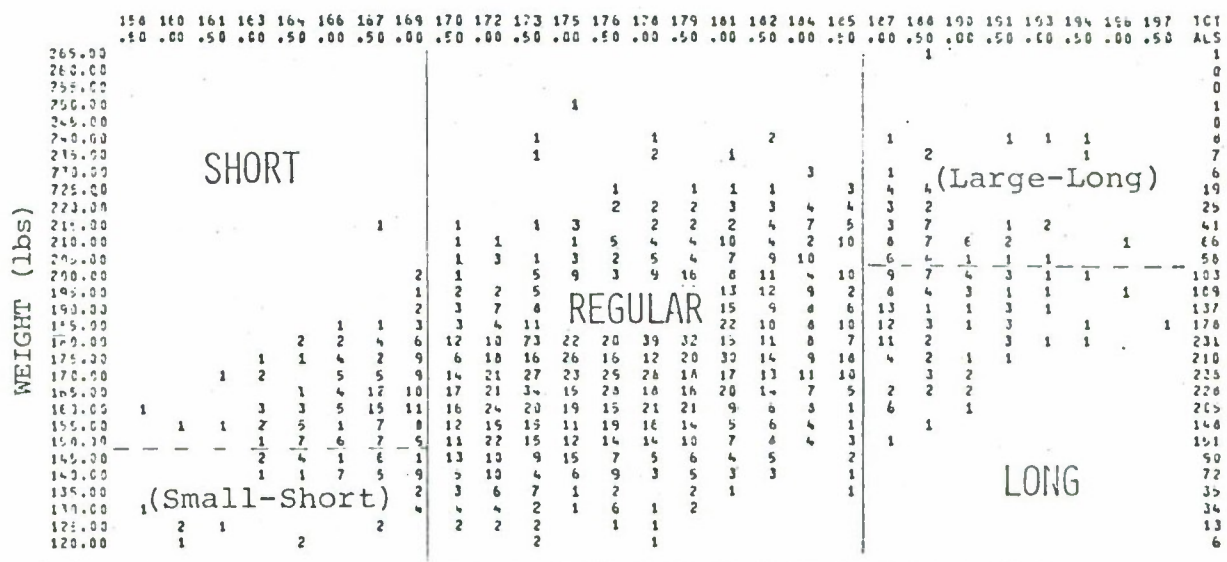
1968 WAF Stature-Weight Bivariate Distribution



WEIGHT (lbs)	145 .25	147 .25	149 .25	151 .25	153 .25	155 .25	157 .25	159 .25	161 .25	163 .25	165 .25	167 .25	169 .25	171 .25	173 .25	175 .25	177 .25	179 .25	181 .25	183 .25	TOT ALS
200.00										1							1				2
195.00									1					1							2
190.00										1		1									2
185.00										2	2			3							7
180.00													2	1							3
175.00										1		3	1			1					7
170.00					1		1	1	1	1		2	1	2	1						14
165.00								2	1	1	1	5	1	3	3						17
160.00						1		3	1	4	1	6	4	5	3		1	1			30
155.00							4	1	4	6	9	6	4	8	3	1	1	2			49
150.00				1		2		3	2	10	9	16	14	7	5		1				72
145.00			1				4	2					18	8	10	3	4	2			122
140.00			1		1	7	11	9					22	8	3	4	1		1		142
135.00				1	3	9	13	15					14	8	13	3		1			181
130.00		1		5	5	14	14	28	35	39	35	26	12	13	3			1			231
125.00			2	5	10	16	28	35	42	32	23	23	11	6	4	1	2	1			241
120.00				6	11	18	27	38	44	22	23	13	12	4	1		1	1			221
115.00		3	4	7	15	24	32	33	40	19	11	11	6	3	1						209
110.00		2	2	8	18	23	26	20	21	17	4	5	2	2	2						152
105.00		1	3	12	11	24	18	13	14	9	4	3	1								113
100.00	2		1	11	10	14	7	7	5	3		1									61
95.0						8	3	1	2												22
90.0							2														4
85.00					1																1
TOTALS	2	6	17	60	88	160	190	211	260	241	183	187	125	82	53	13	14	9	1	1	1905

FIGURE 6.

1967 Air Force Stature-Weight Bivariate Distribution



WEIGHT (lbs)	156 .50	158 .00	161 .50	163 .00	164 .50	166 .00	167 .50	169 .00	170 .50	172 .00	173 .50	175 .00	176 .50	178 .00	179 .50	181 .00	182 .50	184 .00	185 .50	187 .00	188 .50	190 .00	191 .50	193 .00	194 .50	196 .00	197 .50	TOT ALS
265.00																					1						1
260.00																												0
255.00																												0
250.00												1																1
245.00																												0
240.00											1			1			2				1			1	1	1		8
235.00											1			2		1					2				1			7
230.00																		3			1							6
225.00													1		1	1	1		3		4							19
220.00													2	2	2	3	3	4	4		3	2						25
215.00							1		1		1	3		2	2	2	4	7	5		3	7		1	2			41
210.00									1	1		1	5	4	4	10	4	2	10		8	7	6	2			1	66
205.00									1	3	1	3	2	5	4	7	9	10			6	4	1	1	1			58
200.00								2	1		5	9	3	9	16	8	11	6	10		9	7	4	3	1	1		103
195.00								1	2	2	5					13	12	9	2		8	4	3	1	1		1	109
190.00								2	3	7	8					15	9	8	6		13	1	1	3	1			137
185.00						1	1	3	3	4	11					22	10	8	10		12	3	1	3		1		176
180.00					2	2	4	6	12	10	13	22	20	39	32	15	11	8	7		11	2		3	1	1		231
175.00				1	1	4	2	9	6	18	16	26	16	12	20	30	14	9	18		4	2	1	1				210
170.00			1	2		5	5	9	14	21	27	23	25	26	18	17	13	11	10			3	2					235
165.00					1	4	12	10	17	21	34	15	23	18	18	20	14	7	5		2	2	2					226
160.00	1			3	3	5	15	11	16	24	20	19	15	21	21	9	6	3	1		6		1					265
155.00		1	1	2	5	1	7	8	12	15	15	11	19	16	14	5	6	4	1			1						148
150.00				1	7	6	7	9	11	22	15	12	14	14	10	7	4	4	3		1							191
145.00				2	4	1	6	1	13	13	9	15	7	5	6	4	5		2									90
140.00				1	1	7	5	9	5	10	4	6	9	3	5	3	3		1									72
135.00								2	3	6	7	1	2		2	1			1									35
130.00								4	4	4	2	1	6	1	2													34
125.00		2	1				2		2	2	2		1	1														13
120.00		1			2						2			1														6
TOTALS	2	5	6	14	31	39	70	86	127	184	209	198	221	242	234	193	145	106	99	92	52	24	20	10	6	2	1	2420

the 5th percentile population values. The dimensional variables listed in the first column of this table are selected, on the basis of their potential usefulness to designers, from a much larger group of variables measured in the survey. The 5th percentile population values are listed in the second column; the third column contains the "small-short" subgroup means, followed by their deviations and the deviations in percent from the 5th percentile population values. The final three columns in the table list the predicted or multiple regression values for each variable, based on the 5th percentile height and weight as input, with their accompanying deviations and percent deviations from the 5th percentile values.

Table 7 shows the corresponding statistics for a "large-long" subset consisting of those individuals who exceed the 90th percentiles for weight and height.* The statistics for the "medium-regular" subgroup are not included because, in general, they correspond closely to the average value of the total group.

A study of Table 6 shows that the subgroup is, on the average, lighter (4.5 lbs) and shorter (1.7 cm) than the 5th percentile values. The degree of correspondence for the majority of variables is, in general, surprisingly good. On the first

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* Similar listings are given in Appendix A, Tables A-1 through A-4, for subgroups based on the variables of weight and sitting height, as opposed to weight and stature as shown here. Sitting height is often a more valid criterion than stature for studies of cockpit and other seated work station accommodations.

and USAF-1967 Regression Values*

Variable	5%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
Weight	140.2	135.7	-4.5	(3.2)	140.2	-	-
Height (Stature)	167.2	165.5	-1.7	(1.0)	167.3	-	-
Cervicale Height	142.5	140.7	-1.8	(1.3)	142.7	0.2	(0.1)
Acromion Height	135.7	133.8	-1.9	(1.4)	135.9	0.2	(0.1)
Radiale Height	104.8	103.5	-1.3	(1.2)	105.1	0.3	(0.3)
Stylion Height	80.2	79.7	-0.5	(0.6)	80.9	0.7	(0.9)
Dactylion Height	61.5	61.3	-0.2	(0.3)	62.5	1.0	(1.6)
Suprasternale Ht	136.3	134.6	-1.7	(1.2)	136.2	0.1	(0.1)
Nipple Height	120.8	119.8	-1.0	(0.8)	121.2	0.4	(0.3)
Waist Ht-Omphalion	98.7	98.2	-0.5	(0.5)	99.7	1.0	(1.0)
Iliocristale Ht	101.3	100.3	-1.0	(1.0)	101.9	0.6	(0.6)
Buttock Height	83.1	82.6	-0.5	(0.6)	83.9	0.8	(1.0)
Trochanterion Ht	86.9	86.5	-0.4	(0.5)	87.9	1.0	(1.2)
Gluteal Furrow Ht	74.6	74.3	-0.3	(0.4)	75.6	1.0	(1.3)
Crotch Height	78.3	78.4	0.1	(0.1)	79.6	1.3	(1.7)
Patella Top Height	48.5	48.4	-0.1	(0.2)	49.1	0.6	(1.2)
Knee Circ Height	45.7	45.5	-0.2	(0.4)	46.1	0.4	(0.9)
Fibular Height	40.2	40.2	-	-	40.7	0.5	(1.2)
Calf Height	32.0	32.4	0.4	(1.3)	32.8	0.8	(2.5)
Ankle Height	12.0	12.8	0.8	(6.7)	12.9	0.9	(7.5)
Sitting Height	88.1	88.5	0.4	(0.5)	89.0	0.9	(1.0)
Eye Height/Sitting	76.1	76.7	0.6	(0.8)	77.2	1.1	(1.4)
Midshoulder Ht/Sit	60.2	60.3	0.1	(0.2)	61.1	0.9	(1.5)
Acromion Height/Sit	56.5	56.8	0.3	(0.5)	57.6	1.1	(1.9)
Elbow Rest Ht/Sit	20.9	23.5	2.6	(12.4)	23.9	3.0	(14.4)
Knee Height/Sitting	51.7	51.2	-0.5	(1.0)	52.0	0.3	(0.6)
Popliteal Ht/Sit	40.0	40.5	0.5	(1.3)	40.9	0.9	(2.3)
Buttock-Knee Length	56.0	55.6	-0.4	(0.7)	56.4	0.4	(0.7)
Buttock-Popliteal	46.1	46.2	0.1	(0.2)	47.0	0.9	(2.0)
Shoulder-Elbow Lg	33.2	33.3	0.1	(0.3)	33.8	0.6	(1.8)
Acromion-Radiale Lg	30.2	30.3	0.1	(0.3)	30.9	0.7	(2.3)
Elbow-Wrist Length	27.7	27.9	0.2	(0.7)	28.3	0.6	(2.2)
Radiale-Stylion Lg	24.6	24.7	0.1	(0.4)	25.2	0.6	(2.4)
Elbow-Grip Length	32.6	32.8	0.2	(0.6)	33.2	0.6	(1.8)
Thumb-Tip Reach	73.9	75.1	1.2	(1.6)	75.7	1.8	(2.4)
Thumb-Tip Reach/Extd	82.3	83.7	1.4	(1.7)	84.7	2.4	(2.9)
Sleeve Inseam	44.4	45.2	0.8	(1.8)	45.8	1.4	(3.2)
Biacromial Breadth	37.5	39.0	1.5	(4.0)	39.1	1.6	(4.3)
Bideltoid Breadth	44.1	44.7	0.6	(1.4)	45.4	1.3	(2.9)
Chest Breadth	29.5	30.0	0.5	(1.7)	30.6	1.1	(3.7)
Waist Breadth-Omph	27.2	27.4	0.2	(0.7)	28.2	1.0	(3.7)
Hip Breadth	32.3	32.3	-	-	32.9	0.6	(1.9)
Hip Breadth Sitting	34.2	34.2	-	-	34.9	0.7	(2.0)
Elbow Breadth Bone/R	6.5	6.7	0.2	(3.1)	6.8	0.3	(4.6)
Forearm-Forearm Br	48.2	49.9	1.7	(3.5)	50.9	2.7	(5.6)
Knee Breadth Bone/R	9.3	9.4	0.1	(1.1)	9.5	0.2	(2.2)
Chest Depth	21.3	22.1	0.8	(3.8)	22.7	1.4	(6.6)
Waist Depth-Omph	18.9	19.7	0.8	(4.2)	20.3	1.4	(7.4)
Buttock Depth	20.7	21.1	0.4	(1.9)	21.8	1.1	(5.3)
Thigh Clearance Ht	14.3	15.0	0.7	(4.9)	15.2	0.9	(6.3)

* Weight in pounds. All other measurement values in centimeters.
Small-short subgroup n=60.

and USAF-1967 Regression Values*

Variable	5%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
Neck Circ - Max	35.4	36.3	0.9	(2.5)	36.6	1.2	(3.4)
Shoulder Circ	108.4	109.1	0.7	(0.6)	110.9	2.5	(2.3)
Chest Circumference	88.6	89.7	1.1	(1.2)	91.7	3.1	(3.5)
Waist Circ-Omph	75.7	77.2	1.5	(2.0)	79.6	3.9	(5.2)
Waist Circ-Omph/Sit	75.4	77.4	2.0	(2.7)	79.8	4.4	(5.8)
Buttock Circ	89.7	89.7	-	-	91.4	1.7	(1.9)
Buttock Circ/Sit	97.1	97.3	0.2	(0.2)	99.2	2.1	(2.2)
Vertical Trunk Circ	156.7	154.3	-2.4	(1.5)	157.2	0.5	(0.4)
Vert Trunk Circ/Sit	150.4	148.7	-1.7	(1.1)	151.1	0.7	(0.5)
Upper Thigh Circ	51.5	52.9	1.4	(2.7)	54.0	2.5	(4.9)
Upper Thigh Circ/Sit	50.8	51.8	1.0	(2.0)	53.0	2.2	(4.3)
Knee Circumference	35.4	35.5	0.1	(0.3)	36.0	0.6	(1.7)
Knee Circ/Sitting	36.0	36.1	0.1	(0.3)	36.5	0.5	(1.4)
Calf Circ/Right	33.5	34.1	0.6	(1.8)	34.9	1.4	(4.2)
Ankle Circumference	20.4	20.9	0.5	(2.5)	21.1	0.7	(3.4)
Scye Circumference	43.8	44.1	0.3	(0.7)	45.2	1.4	(3.2)
Biceps Circ/Extd/R	27.0	28.0	1.0	(3.7)	28.6	1.6	(5.9)
Biceps Circ/Flexd/R	29.1	30.0	0.9	(3.1)	30.6	1.5	(5.2)
Elbow Circ-Extended	25.4	25.7	0.3	(1.2)	26.0	0.6	(2.4)
Elbow Circ-Flexed	28.5	28.9	0.4	(1.4)	29.5	1.0	(3.5)
Lower Arm Circ/Flexd	27.2	27.8	0.6	(2.2)	28.1	0.9	(3.3)
Wrist Circumference	16.2	16.6	0.4	(2.5)	16.7	0.5	(3.1)
Sleeve Lg/Spine-Scye	25.5	26.7	1.2	(4.7)	26.9	1.4	(5.5)
Sleeve L/Spine-Elbow	56.4	56.6	0.2	(0.4)	57.2	0.8	(1.4)
Sleeve L/Spine-Wrist	85.2	84.7	-0.5	(0.6)	85.8	0.6	(0.7)
Shoulder Length	14.6	15.6	1.0	(6.8)	15.8	1.2	(8.2)
Interscye	32.5	36.4	3.9	(12.0)	36.8	4.3	(13.2)
Interscye Maximum	56.6	57.2	0.6	(1.1)	58.1	1.5	(2.7)
Waist Front-Omph	36.9	37.8	0.9	(2.4)	38.2	1.3	(3.5)
Crotch Lg-Omphalion	63.6	64.4	0.8	(1.3)	65.5	1.9	(3.0)
Waist Back-Omphalion	43.1	43.8	0.7	(1.6)	44.4	1.3	(3.0)
Foot Length	25.1	25.6	0.5	(2.0)	25.6	0.5	(2.0)
Foot Breadth	9.0	9.2	0.2	(2.2)	9.3	0.3	(3.3)
Ball-of-Foot Circ	22.9	23.4	0.5	(2.2)	23.6	0.7	(3.1)
Bi-Malleolar Br	6.7	6.9	0.2	(3.0)	6.9	0.2	(3.0)
Lateral Malleolus Ht	6.2	6.5	0.3	(4.8)	6.6	0.4	(6.5)
Medial Malleolus Ht	7.6	8.1	0.5	(6.6)	8.1	0.5	(6.6)
Hand Length	17.8	18.1	0.3	(1.7)	18.2	0.4	(2.2)
Palm Length	10.0	10.2	0.2	(2.0)	10.3	0.3	(3.0)
Hand Br/Metacarpale	8.2	8.5	0.3	(3.7)	8.5	0.3	(3.7)
Hand C/Metacarpale	20.0	20.6	0.6	(3.0)	20.7	0.7	(3.5)
Hand Thick/Meta-3	2.4	2.7	0.3	(12.5)	2.7	0.3	(12.5)
Head Circumference	55.2	56.3	1.1	(2.0)	56.5	1.3	(2.4)
Head Length	18.8	19.5	0.7	(3.7)	19.5	0.7	(3.7)
Head Breadth	14.7	15.3	0.6	(4.1)	15.4	0.7	(4.8)

* Weight in pounds. All other measurements values in centimeters. Small-short subgroup n=60.

and USAF-1967 Regression Values*

riable	95%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
ight	210.8	215.6	4.8	(2.3)	210.8	-	-
ight (Stature)	187.7	188.5	0.8	(0.4)	187.7	-	-
rvicale Height	161.8	162.4	0.6	(0.4)	161.8	-	-
romion Height	154.8	155.5	0.7	(0.5)	154.9	0.1	(0.1)
diale Height	120.0	120.3	0.3	(0.3)	119.8	-0.2	(0.2)
ylion Height	93.3	93.0	-0.3	(0.3)	92.5	-0.8	(0.9)
ctylion Height	73.2	72.5	-0.7	(1.0)	72.1	-1.1	(1.5)
prasternale Ht	154.5	155.3	0.8	(0.5)	154.5	-	-
pple Height	138.1	138.4	0.3	(0.2)	137.5	-0.6	(0.4)
ist Ht-Omphalion	114.3	113.6	-0.7	(0.6)	113.5	-0.8	(0.7)
iocristale Ht	117.2	116.9	-0.3	(0.3)	116.7	-0.5	(0.4)
ttock Height	97.5	96.8	-0.7	(0.7)	96.5	-1.0	(1.0)
ochanterion Ht	101.3	100.4	-0.9	(0.9)	100.2	-1.1	(1.1)
uteal Furrow Ht	87.9	87.1	-0.8	(0.9)	86.8	-1.1	(1.3)
otch Height	92.0	90.8	-1.2	(1.3)	90.6	-1.4	(1.3)
tella Top Height	56.9	56.4	-0.5	(0.9)	56.3	-0.6	(1.1)
ee Circ Height	53.9	53.4	-0.5	(0.9)	53.3	-0.6	(1.1)
bular Height	47.6	47.0	-0.6	(1.3)	47.0	-0.6	(1.3)
lf Height	39.3	38.6	-0.7	(1.8)	38.4	-0.9	(2.3)
kle Height	15.8	14.5	-1.3	(8.2)	14.6	-1.2	(7.6)
tting Height	98.6	98.2	-0.4	(0.4)	97.6	-1.0	(1.0)
e Height/Sitting	86.1	85.5	-0.6	(0.7)	84.8	-1.3	(1.5)
dshoulder Ht/Sitting	69.2	68.8	-0.4	(0.6)	68.3	-0.9	(1.3)
romion Ht/Sitting	65.9	65.1	-0.8	(1.2)	64.7	-1.2	(1.8)
bow Rest Ht/Sitting	29.5	26.8	-2.7	(9.2)	26.5	-3.0	(10.2)
ee Height/Sitting	59.9	59.9	-	-	59.7	-0.2	(0.3)
pliteal Ht/Sitting	47.5	46.7	-0.8	(1.7)	46.5	-1.0	(2.1)
ttock-Knee Length	65.0	64.8	-0.2	(0.3)	64.6	-0.4	(0.6)
ttock-Popliteal	54.6	54.2	-0.4	(0.7)	54.0	-0.6	(1.1)
oulder-Elbow Length	38.8	38.3	-0.5	(1.3)	38.1	-0.7	(1.8)
romion-Radiale Lg	35.8	35.2	-0.6	(1.7)	35.0	-0.8	(2.2)
bow-Wrist Length	32.4	31.8	-0.6	(1.9)	31.8	-0.6	(1.9)
diale-Stylion Lg	29.2	28.6	-0.6	(2.1)	28.6	-0.6	(2.1)
bow-Grip Length	37.9	37.3	-0.6	(1.6)	37.3	-0.6	(1.6)
umb-Tip Reach	87.0	85.5	-1.5	(1.7)	85.1	-1.9	(2.2)
umb-Tip R'ch Extended	97.3	95.0	-2.3	(2.4)	94.7	-2.6	(2.7)
eeve Inseam	52.8	51.4	-1.4	(2.7)	51.3	-1.5	(2.8)
acromial Breadth	43.8	42.7	-1.1	(2.5)	42.6	-1.2	(2.7)
deltoid Breadth	52.6	51.5	-1.1	(2.1)	51.5	-1.1	(2.1)
est Breadth	36.5	35.2	-1.3	(3.6)	35.3	-1.2	(3.3)
ist Breadth-Omphalion	35.0	34.2	-0.8	(2.3)	34.1	-0.9	(2.6)
p Breadth	38.5	38.0	-0.5	(1.3)	37.9	-0.6	(1.6)
p Breadth/Sitting	41.8	41.3	-0.5	(1.2)	41.0	-0.8	(1.9)
bow Breadth Bone/R	7.7	7.5	-0.2	(2.6)	7.4	-0.3	(3.9)
rearm-Forearm Breadth	60.7	58.3	-2.4	(4.0)	58.3	-2.4	(4.0)
ee Breadth Bone/R	10.7	10.6	-0.1	(0.9)	10.5	-0.2	(1.9)
est Depth	27.7	26.7	-1.0	(3.6)	26.7	-1.0	(3.6)
ist Depth-Omphalion	26.1	24.8	-1.3	(5.0)	24.6	-1.5	(5.7)
ttock Depth	27.5	26.6	-0.9	(3.5)	26.4	-1.1	(4.0)
igh Clearance Height	18.8	18.3	-0.5	(2.7)	18.1	-0.7	(3.7)

Weight in pounds. All other measurement values in centimeters.
Large-long subgroup n=89.

and USAF-1967 Regression Values*

riable	95%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
ck Circ Maximum	41.6	40.6	-1.0	(2.4)	40.4	-1.2	(2.9)
oulder Circ	127.6	125.6	-2.0	(1.6)	125.4	-2.2	(1.7)
est Circumference	109.4	106.3	-3.1	(2.8)	106.5	-2.9	(2.7)
ist Circ-Omphalion	100.1	97.3	-2.8	(2.8)	96.9	-3.2	(3.2)
ist Circ-Omph/Sit	100.2	96.4	-3.8	(3.8)	96.2	-4.0	(4.0)
ttock Circumference	107.9	107.3	-0.6	(0.6)	106.8	-1.1	(1.0)
ttock Circ/Sitting	119.3	117.9	-1.4	(1.2)	117.2	-2.1	(1.8)
rtical Trunk Circ	180.2	181.0	0.8	(0.4)	179.9	-0.3	(0.2)
rt Trunk Circ/Sit	173.2	173.1	-0.1	(0.6)	172.3	-0.9	(0.6)
per Thigh Circ	66.2	65.2	-1.0	(1.5)	64.4	-1.8	(2.7)
per Thigh Circ/Sit	65.0	64.0	-1.0	(1.5)	63.5	-1.5	(2.3)
ee Circumference	42.2	41.8	-0.4	(0.9)	41.7	-0.5	(1.2)
ee Circ/Sitting	43.0	42.6	-0.4	(0.9)	42.4	-0.6	(1.4)
lf Circ/Right	41.0	40.1	-0.9	(2.2)	39.9	-0.1	(0.2)
kle Circumference	24.6	24.0	-0.6	(2.4)	23.9	-0.7	(2.8)
ye Circumference	53.0	51.6	-1.4	(2.6	51.9	-1.1	(2.1)
ceps Circ/Extended/R	34.7	33.5	-1.2	(3.5)	33.4	-1.3	(3.7)
ceps Circ/Flexed/R	36.6	35.5	-1.1	(3.0)	35.3	-1.3	(3.6)
bow Circ-Extended	30.1	29.6	-0.5	(1.7)	29.5	-0.6	(2.0)
bow Circ-Flexed	34.2	33.4	-0.8	(2.3)	33.2	-1.0	(2.9)
wer Arm Circ-Flexed	32.4	31.7	-0.7	(2.2)	31.6	-0.8	(2.5)
ist Circumference	19.2	18.6	-0.6	(3.1)	18.6	-0.6	(3.1)
eeve L/Spine-Scye	31.5	30.4	-1.1	(3.5)	30.1	-1.4	(4.4)
eeve L/Spine-Elbow	65.0	64.6	-0.4	(0.6)	64.1	-0.9	(1.4)
eeve L/Spine-Wrist	96.8	96.5	-0.3	(0.3)	96.1	-0.7	(0.7)
oulder Length	18.7	17.6	-1.1	(5.9)	17.5	-1.2	(6.4)
terscye	45.0	40.5	-4.5	(10.0)	41.0	-4.0	(8.9)
terscye Maximum	66.6	65.5	-1.1	(1.7)	65.4	-1.2	(1.8)
ist Front-Omphalion	44.2	43.6	-0.6	(1.4)	42.9	-1.3	(2.9)
otch Length-Omphalion	78.2	76.6	-1.6	(2.0)	76.3	-1.9	(2.4)
ist Back-Omphalion	50.9	49.9	-1.0	(2.0)	49.6	-1.3	(2.6)
ot Length	29.0	28.7	-0.3	(1.0)	28.6	-0.4	(1.4)
ot Breadth	10.6	10.3	-0.3	(2.8)	10.3	-0.3	(2.8)
ll-of-Foot Circ	27.0	26.2	-0.8	(3.0)	26.2	-0.8	(3.0)
-Malleolar Breadth	8.0	7.7	-0.3	(3.8)	7.7	-0.3	(3.8)
teral Malleolus Ht	8.0	7.5	-0.5	(6.3)	7.5	-0.5	(6.3)
dial Malleolus Ht	9.5	9.0	-0.5	(5.3)	9.1	-0.4	(4.2)
nd Length	20.5	20.0	-0.5	(2.4)	20.1	-0.4	(2.0)
lm Length	11.7	11.3	-0.4	(3.4)	11.4	-0.3	(2.6)
nd Br/Metacarple	9.6	9.4	-0.2	(2.1)	9.3	-0.3	(3.1)
nd Circ/Metacarpale	23.1	22.6	-0.5	(2.2)	22.5	-0.6	(2.6)
nd Thick/Meta-3	3.1	2.9	-0.2	(6.5)	2.9	-0.2	(6.5)
ad Circumference	59.9	58.7	-1.2	(2.0)	58.7	-1.2	(2.0)
ad Length	21.0	20.3	-0.7	(3.3)	20.3	-0.7	(3.3)
ad Breadth	16.5	15.9	-0.6	(3.6)	15.9	-0.6	(3.6)

Weight in pounds. All other measurement values in centimeters.
Large-long subgroup n=89.

and WAF-1968 Regression Values*

ıriable	5%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
ːight	102.3	100.7	-1.6	(1.6)	102.3	-	-
ːature	152.4	151.5	-0.9	(0.6)	152.4	-	-
ːature, Maximum	152.9	152.0	-0.9	(0.6)	153.0	0.1	(0.1)
ːrvicale Height	130.3	129.7	-0.6	(0.5)	130.4	0.1	(0.1)
ːromial Height	123.0	122.3	-0.7	(0.6)	123.1	0.1	(0.1)
ıprasternale Ht	123.4	122.6	-0.8	(0.6)	123.5	0.1	(0.1)
ıst Point Height	110.0	109.7	-0.3	(0.3)	110.7	0.7	(0.6)
ıist Height	93.1	92.9	-0.2	(0.2)	93.6	0.5	(0.5)
ɔdominal Ext Ht	86.1	86.3	0.2	(0.2)	86.9	0.8	(0.9)
ːochanteric Ht	75.7	76.0	0.3	(0.4)	76.8	1.1	(1.5)
ıttock Height	75.4	75.9	0.5	(0.7)	76.4	1.0	(1.3)
ʟuteal Furrow Ht	66.4	67.0	0.6	(0.9)	67.7	1.3	(2.0)
ıbiale Height	38.2	38.7	0.5	(1.3)	39.0	0.8	(2.1)
ːotch Height	68.1	68.6	0.5	(0.7)	69.0	0.9	(1.3)
ıkle Height	9.2	10.5	1.3	(14.1)	10.5	1.3	(14.1)
ıteral Malleolus Ht	5.8	6.4	0.6	(10.3)	6.4	0.6	(10.3)
ıtting Ht, Relaxed	78.9	79.7	0.8	(1.0)	80.1	1.2	(1.5)
ıtting Height	80.4	80.9	0.5	(0.6)	81.3	0.9	(1.1)
ʼe Height, Sitting	68.7	69.6	0.9	(1.3)	69.9	1.2	(1.7)
ıdshoulder Ht, Sit	53.7	54.3	0.6	(1.1)	54.6	0.9	(1.7)
ıist Ht, Sitting	20.5	21.7	1.2	(5.9)	22.0	1.5	(7.3)
ʟbow Rest Height	18.7	21.6	2.9	(15.5)	21.8	3.1	(16.6)
ɔpliteal Height	38.0	38.8	0.8	(2.1)	38.9	0.9	(2.4)
ıttock-Popliteal L	43.5	44.0	0.5	(1.1)	44.3	0.8	(1.8)
ıttock-Knee Length	53.2	52.8	-0.4	(0.8)	53.5	0.3	(0.6)
ːromion-Radial Lgth	28.3	29.0	0.7	(2.5)	29.1	0.8	(2.8)
ıdiale-Stylion Lgth	21.2	21.9	0.7	(3.3)	21.9	0.7	(3.3)
ıumb-Tip Reach	67.7	69.6	1.9	(2.8)	69.8	2.1	(3.1)
ıumb-Tip, Extended	76.0	78.3	2.3	(3.0)	78.6	2.6	(3.4)
ʼerhead Reach	185.2	185.5	0.3	(0.2)	187.2	2.0	(1.1)
ːck Circumference	31.1	32.4	1.3	(4.2)	32.3	1.2	(3.9)
ıoulder Circ	92.6	93.8	1.2	(1.3)	94.6	2.0	(2.2)
ıest Circ at Scye	77.0	78.4	1.4	(1.8)	79.0	2.0	(2.6)
ıst Circumference	81.6	83.9	2.3	(2.8)	84.0	2.4	(2.9)
ıest Circ Below Bust	67.2	68.9	1.7	(2.5)	69.3	2.1	(3.1)
ıist Circumference	59.5	61.0	1.5	(2.5)	61.4	1.9	(3.2)
ɔdominal Ext Circ	74.8	77.1	2.3	(3.1)	78.4	3.6	(4.8)
ıp C-7" Below Waist	85.1	85.5	0.4	(0.5)	86.9	1.8	(2.1)
ıp C-9" Below Waist	85.8	86.4	0.6	(0.7)	88.0	2.2	(2.6)
ɔper Thigh Circ	48.7	50.1	1.4	(2.9)	51.0	2.3	(4.7)
ıee Circumference	32.8	33.1	0.3	(0.9)	33.6	0.8	(2.4)
ılf Circ, Right	30.6	31.3	0.7	(2.3)	31.9	1.3	(4.2)
ıkle Circumference	19.0	19.6	0.6	(3.2)	19.9	0.9	(4.7)
ːrtical Trunk Circ	143.5	143.8	0.3	(0.2)	144.7	1.2	(0.8)
ːrt Trunk Circ, Sit	139.4	139.7	0.3	(0.2)	140.6	1.2	(0.9)
ıttock Circ, Sit	90.9	91.2	0.3	(0.3)	92.4	1.5	(1.7)
ːye Circumference	33.6	34.3	0.7	(2.1)	34.6	1.0	(3.0)
ːillary Arm Circ	23.9	24.9	1.0	(4.2)	25.3	1.4	(5.9)
ːceps C, Relaxed, R	22.2	23.2	1.0	(4.5)	23.6	1.4	(6.3)
ːceps C, Flexed, R	23.3	24.3	1.0	(4.3)	24.7	1.4	(6.0)

Weight in pounds. All other measurement values in centimeters.
Small-short subgroup n=59.

Comparison of 5th Percentile Values With Small-Short Subgroup Values and WAF-1968 Regression Values*

Variable	5%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(
Elbow Circ, Flexed	24.2	24.8	0.6	(2.5)	25.2	1.0	(4
Forearm C, Relaxed	21.3	21.6	0.3	(1.4)	22.0	0.7	(3
Forearm C, Flexed	22.6	23.1	0.5	(2.2)	23.4	0.8	(3
Wrist Circumference	13.8	14.1	0.3	(2.2)	14.2	0.4	(2
Biacromial Breadth	33.2	34.0	0.8	(2.4)	34.3	1.1	(3
Bideltoid Breadth	38.2	38.8	0.6	(1.6)	39.4	1.2	(3
Chest Breadth	25.1	25.9	0.8	(3.2)	26.2	1.1	(4
Bust Pt-Bust Pt Br	16.1	17.4	1.3	(8.1)	17.4	1.3	(8
Waist Breadth	21.2	21.9	0.7	(3.3)	22.1	+0.9	(4
Hip Breadth	31.6	32.0	0.4	(1.3)	32.6	1.0	(3
Thigh-Thigh Br, Sit	33.8	34.6	0.8	(2.4)	35.4	1.6	(4
Humeral Breadth, R	5.6	5.8	0.2	(3.6)	5.8	-2.8	(3
Femoral Breadth, R	7.4	7.8	0.4	(5.4)	7.7	0.3	(4
Chest Depth	20.9	21.9	1.0	(4.8)	21.9	1.0	(4
Waist Depth	14.8	15.4	0.6	(4.1)	15.5	0.7	(4
Abdominal Ext Depth	17.9	18.7	0.8	(4.5)	18.9	1.0	(5
Buttock Depth	18.4	19.0	0.6	(3.3)	19.4	1.0	(5
Thigh Clearance	10.4	10.9	0.5	(4.8)	11.0	0.6	(5
Shoulder Length	13.0	13.9	0.9	(6.9)	14.0	1.0	(7
Neck-Bust Point Lgth	22.5	24.1	1.6	(7.1)	24.0	1.5	(6
Strap Length	59.2	61.8	2.6	(4.4)	61.5	2.3	(3
Interscye	31.2	33.2	2.0	(6.4)	33.4	2.2	(7
Interscye, Maximum	43.9	46.1	2.2	(5.0)	46.4	2.5	(5
Back Curvature	37.6	39.4	1.8	(4.8)	39.7	2.1	(5
Waist Back	37.0	38.3	1.3	(3.5)	38.4	1.4	(3
Anterior Waist Lgth	30.5	31.6	1.1	(3.6)	31.8	1.3	(4
Sleeve Inseam	40.2	41.4	1.2	(3.0)	41.6	1.4	(3
Spine-To-Scye Lgth	18.3	19.7	1.4	(7.7)	19.4	1.1	(6
Spine-To-Elbow Lgth	49.4	50.0	0.6	(1.2)	50.2	0.8	(1
Spine-To-Wrist Lgth	74.2	74.6	0.4	(0.5)	75.0	0.8	(1
Hand Length	16.9	17.4	0.5	(3.0)	17.4	0.5	(3
Hand Breadth	6.9	7.2	0.3	(4.3)	7.2	0.3	(4
Hand Circumference	16.8	17.5	0.7	(4.2)	17.5	0.7	(4
Foot Length	22.2	22.5	0.3	(1.4)	22.7	0.5	(2
Foot Breadth	8.0	8.4	0.4	(5.0)	8.5	0.5	(6
Head Length	17.3	17.9	0.6	(3.5)	18.0	0.7	(4
Head Breadth	13.5	14.3	0.8	(5.9)	14.3	0.8	(5
Head Circumference	52.3	53.4	1.1	(2.1)	53.7	1.4	(2

* Weight in pounds. All other measurement values in centimeters. Small-short subgroup n=59.

and WAF-1968 Regression Values*

iable	95%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
ght	156.4	160.7	4.3	(2.7)	156.3	-0.1	(0.1)
ture	172.2	172.7	0.5	(2.9)	172.2	-	-
ture, Maximum	172.8	173.4	0.6	(0.3)	172.8	-	-
vicale Height	148.4	149.0	0.6	(0.4)	148.4	-	-
romial Height	141.1	141.5	0.4	(0.3)	140.9	-0.2	(0.1)
rasternale Ht	140.9	141.5	0.6	(0.4)	140.9	-	-
t Point Height	127.3	126.6	-0.7	(0.5)	126.2	-1.1	(0.9)
ist Height	107.9	107.7	-0.2	(0.2)	107.2	-0.7	(0.6)
lominal Ext Ht	100.7	100.0	-0.7	(0.7)	99.5	-1.2	(1.2)
chanteric Ht	89.8	89.3	-0.5	(0.6)	88.8	-1.0	(1.1)
tock Height	89.2	88.9	-0.3	(0.3)	88.2	-1.0	(1.1)
teal Furrow Ht	79.4	78.6	-0.8	(1.0)	77.8	-1.6	(2.0)
iale Height	46.1	45.7	-0.4	(0.9)	45.1	-1.0	(2.2)
tch Height	81.4	80.9	-0.5	(0.6)	80.1	-1.3	(1.6)
le Height	13.6	12.1	-1.5	(11.0)	11.9	-1.7	(12.5)
eral Malleolus Ht	7.8	7.2	-0.6	(7.7)	7.2	-0.6	(7.7)
ting Height, Relaxed	89.7	88.6	-1.1	(1.2)	88.7	-1.0	(1.1)
ting Height	90.9	90.2	-0.7	(0.8)	90.1	-0.8	(0.9)
Height, Sitting	78.8	77.8	-1.0	(1.3)	77.7	-1.1	(1.4)
lshoulder Ht, Sit	62.5	61.5	-1.0	(1.6)	61.6	-0.9	(1.4)
st Height, Sitting	26.2	24.8	-1.4	(5.3)	24.9	-1.3	(5.0)
ow Rest Height	26.9	23.2	-3.7	(13.8)	23.7	-3.2	(11.9)
liteal Height	44.1	43.7	-0.4	(0.9)	43.3	-0.8	(1.8)
tock-Popliteal Lgth	52.6	51.9	-0.7	(1.3)	51.4	-1.2	(2.3)
tock-Knee Length	61.9	61.9	-	-	61.7	-0.2	(0.3)
romion-Radiale Lgth	33.6	33.3	-0.3	(0.9)	33.1	-0.5	(1.5)
diale-Stylion Lgth	25.7	25.1	-0.6	(2.3)	25.0	-0.7	(2.7)
mb-Tip Reach	80.5	78.7	-1.8	(2.2)	78.7	-1.8	(2.2)
mb-Tip, Extended	92.3	89.4	-2.9	(3.1)	89.4	-2.9	(3.1)
rhead Reach	213.3	211.8	-1.5	(0.7)	211.8	-1.5	(0.7)
k Circumference	36.7	35.8	-0.9	(2.5)	35.5	-1.2	(3.3)
ulder Circumference	109.4	108.6	-0.8	(0.7)	107.3	-2.1	(1.9)
st Circ at Scye	93.2	91.9	-1.3	(1.4)	90.5	-2.7	(2.9)
st Circumference	100.2	98.4	-1.8	(1.8)	96.7	-3.5	(3.5)
st Circ Below Bust	83.1	81.6	-1.5	(1.8)	80.4	-2.7	(3.2)
st Circumference	77.2	75.9	-1.3	(1.7)	74.2	-3.0	(3.9)
lominal Ext Circ	98.6	95.4	-3.2	(3.2)	94.4	-4.2	(4.3)
C-7" Below Waist	103.3	101.8	-1.5	(1.5)	101.7	-1.6	(1.6)
C-9" Below Waist	105.6	103.7	-1.9	(1.8)	103.9	-1.7	(1.6)
er Thigh Circ	62.6	61.0	-1.6	(2.6)	60.9	-1.7	(2.7)
e Circumference	40.2	39.6	-0.6	(1.5)	39.4	-0.8	(2.0)
lf Circ, Right	37.9	36.7	-1.2	(3.2)	36.9	-1.0	(2.6)
kle Circumference	23.3	22.3	-1.0	(4.3)	22.5	-0.8	(3.4)
tical Trunk Circ	166.3	165.7	-0.6	(0.4)	165.3	-1.0	(0.6)
t Trunk Circ, Sit	161.0	160.4	-0.6	(0.4)	160.5	-0.5	(0.3)
ttock Circ, Sit	110.8	109.3	-1.5	(1.4)	109.0	-1.8	(1.6)
e Circumference	41.1	40.3	-0.8	(1.9)	40.1	-1.0	(2.4)
llary Arm Circ	31.5	30.6	-0.9	(2.9)	30.1	-1.4	(4.4)
ceps C, Relaxed, R	29.7	28.5	-1.2	(4.0)	28.2	-1.5	(5.1)
ceps C, Flexed, R	30.8	29.7	-1.1	(3.6)	29.4	-1.4	(4.5)

Weight in pounds. All other measurement values in centimeters.
Large-long subgroup n=66.

and WAF-1968 Regression Values*

iable	95%ile Population Value	Subgroup Mean	Δ	(Δ%)	Regression Mean	Δ	(Δ%)
ow Circ, Flexed	30.0	29.0	-1.0	(3.3)	29.0	-1.0	(3.3)
earm Circ, Relaxed	25.8	25.5	-0.3	(1.2)	25.3	-0.5	(1.9)
earm C, Flexed	27.5	27.1	-0.4	(1.5)	26.9	-0.6	(2.2)
ist Circumference	16.2	16.0	-0.2	(1.2)	15.9	-0.3	(1.9)
acromial Breadth	38.6	37.9	-0.7	(1.8)	37.6	-1.0	(2.6)
deltoid Breadth	45.9	45.2	-0.7	(1.5)	44.8	-1.1	(2.4)
est Breadth	31.4	30.5	-0.9	(2.9)	30.2	-1.2	(3.8)
st Pt-Bust Pt Br	21.2	20.2	-1.0	(4.7)	20.0	-1.2	(5.7)
ist Breadth	27.6	27.0	-0.6	(2.2)	26.6	-1.0	(3.6)
p Breadth	38.8	37.6	-1.2	(3.1)	37.8	-1.0	(2.6)
gh-Thigh Br, Sit	43.3	41.7	-1.6	(3.7)	41.6	-1.7	(3.9)
neral Breadth, R	6.7	6.5	-0.2	(3.0)	6.5	-0.2	(3.0)
noral Breadth, R	8.9	8.6	-0.3	(3.4)	8.5	-0.4	(4.5)
est Depth	27.2	26.5	-0.7	(2.6)	25.8	-1.4	(5.1)
ist Depth	20.2	19.2	-1.0	(5.0)	18.8	-1.4	(6.9)
dominal Ext Depth	24.8	23.7	-1.1	(4.4)	23.4	-1.4	(5.6)
tock Depth	24.3	23.4	-0.9	(3.7)	23.3	-1.0	(4.1)
gh Clearance	14.6	14.3	-0.3	(2.1)	14.1	-0.5	(3.4)
oulder Length	16.4	15.6	-0.8	(4.9)	15.4	-1.0	(6.1)
k-Bust Point Lgth	28.8	27.8	-1.0	(3.5)	27.3	-1.5	(5.2)
ap Length	72.1	70.4	-1.7	(2.4)	69.6	-2.5	(3.5)
erscye	39.2	37.3	-1.9	(4.8)	37.1	-2.1	(5.4)
erscye, Maximum	54.7	53.6	-1.1	(2.0)	52.8	-1.9	(3.5)
k Curvature	47.6	45.9	-1.7	(3.6)	45.1	-2.5	(5.3)
ist Back	44.3	42.5	-1.8	(4.1)	42.7	-1.6	(3.6)
erior Waist Lgth	36.9	36.0	-0.9	(2.4)	35.6	-1.3	(3.5)
eve Inseam	48.2	46.8	-1.4	(2.9)	46.7	-1.5	(3.1)
ine-To-Scye Lgth	22.7	21.6	-1.1	(4.8)	21.4	-1.3	(5.7)
ine-To-Elbow Lgth	57.3	57.0	-0.3	(0.5)	56.7	-0.6	(1.0)
ine-To-Wrist Lgth	85.1	85.0	-0.1	(0.1)	84.4	-0.7	(0.8)
nd Length	20.1	19.5	-0.6	(3.0)	19.4	-0.7	(3.5)
nd Breadth	8.2	8.0	-0.2	(2.4)	7.9	-0.3	(3.7)
nd Circumference	19.8	19.3	-0.5	(2.5)	19.2	-0.6	(3.0)
ot Length	26.0	25.6	-0.4	(1.5)	25.6	-0.4	(1.5)
ot Breadth	9.8	9.3	-0.5	(5.1)	9.3	-0.5	(5.1)
nd Length	19.5	18.9	-0.6	(3.1)	18.9	-0.6	(3.1)
nd Breadth	15.5	14.8	-0.7	(4.5)	14.8	-0.7	(4.5)
nd Circumference	57.6	56.2	-1.4	(2.4)	56.2	-1.4	(2.4)

Weight in pounds. All other measurement values in centimeters.
Large-long subgroup n-66.

page the largest percentage difference (Δ%) is for elbow rest height, an anatomically atypical dimension. The dimension is dependent upon two interacting variables; shoulder height, sitting, and shoulder-elbow length as:

Shoulder Height(S)		Shoulder-Elbow Lgth		Elbow Rest Ht
5th Percentile	56.5 -	33.2	≠	20.9
Subgroup Small-Short	56.8 -	33.3	=	23.5

This is the type of inconsistency in 5th percentile values which has caused widespread scepticism of the percentile man concept.

The average deviation from 5th percentile value appears to be somewhat larger for the regression than for the subgroup means. The summary statistics - disregarding the sign (absolute deviation) - are as follows:

USAF Small-Short	Subgroup Mean		Regression Value	
	Δ*	Δ%	Δ*	Δ%
Range	0-3.9	0-12.5	0-4.4	0-14.4
|Mean|	0.71	2.12	1.08	3.17
S.D.	0.66	2.43	0.86	2.64

The "large-long" subgroup's anthropometric values (Table 7) are, in general, smaller than the 95th percentile value throughout despite the fact that the subgroup mean value is greater for both weight and height (4.8 lbs and 8 mm). Some of the deviations are extremely large--particularly the reach dimensions and the torso circumferences. The summary statistics, disregarding sign, are

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* In centimeters, weight not included.

USAF Large-Long	Subgroup Mean		Regression Value	
	Δ*	Δ%	Δ*	Δ%
Range	0-4.5	0-10.0	0-4.0	0-10.2
|Mean|	0.89	2.19	1.01	2.42
S.D.	0.75	1.88	0.78	1.84

Comparable subgroup statistics for the 1968 anthropometric survey of Women of the Air Force data are given in Table 8 ("small-short") and Table 9 ("large-long"). The "small-short" subgroup mean weight and stature are smaller than the 5th percentile values and the "large-long" greater than the 95th percentile values similar to the male comparisons. The remainder of the dimensions are not grossly different from their corresponding percentile values although the arm reach and torso circumferential dimensions exhibit the largest average deviations. The subgroup mean and regression mean deviations, disregarding sign, are shown below.

WAF Small-Short	Subgroup Mean		Regression Mean	
	Δ*	Δ%	Δ*	Δ%
Range	0.2-2.9	0.2-15.5	0-3.6	0-16.6
|Mean|	0.88	3.03	1.20	3.70
S.D.	0.59	2.78	0.71	2.77

WAF Large-Long	Subgroup Mean		Regression Mean	
	Δ*	Δ%	Δ*	Δ%
Range	0-3.7	0-13.8	0-4.2	0-12.5
|Mean|	0.95	2.49	1.21	3.02
S.D.	0.65	2.15	0.80	2.22

* In centimeters, weight not included.

These results are comparable to those obtained for the male data and again indicate that the subgroup deviations are, on the average, smaller than those for the regression means. The subgroup mean values are, however, based upon a relatively small group (n's of 59 to 89) and we might, therefore, expect occasional erratic values to occur on the basis of one or more members of a subgroup having extreme disproportionality. There are sufficient data here, however, to illustrate that the patterns of values are similar for the various subgroups and that the results are not simply variations due to small sample size.

The potential usefulness of either the subgroup mean or, perhaps more appropriately, the regression values to depict the size of "small" and "large" men in design problems should not be overlooked. We would suggest that when it is desirable to depict the range of a population for three-dimensional presentation, the regression mean data be utilized. These data will integrate well, are not unrealistic in nature, and do represent more accurately "average" values for each tail of the distribution. They are, in addition, not so dissimilar from the percentile values as to cause a grievous loss of information to the designer. They would, we believe, be far more appropriate data for body forms for general use, such as in deceleration studies, than the currently used 5th and 95th percentile data. For other than such general use, we would reserve judgment.

Three-dimensional representations for clothing and personal protective equipment design do not normally involve only the tails but the whole of the body size distribution.

The number of forms (sizes) necessary is then a function of the design population to be fitted, the characteristics of the material to be used, and the design item in terms of its form and function. The design solution, in terms of dimensional sizing, is thus often unique to a particular end item and may be wholly inappropriate for other applications. (McConville, et al., 1963; Ziegen, et al., 1960; McConville and Alexander, 1975.)

Drafting board manikins are also a relatively specific application of body size data and as such we are, as yet, unwilling to suggest that the subgroup mean or regression values are more appropriate input data than the currently used percentile values. We do believe, however, that they merit consideration for such applications.

While this discussion has centered on the design limits in body size, as represented by the 5th and 95th percentile body forms, it is recognized that other percentile design limits are often used. Multiple regression equations have, therefore, been included in Appendix B for predicting body size dimensions from the variables of stature and weight, and sitting height and weight. These regression equations were developed using the USAF 1967 and Air Force Women 1968 anthropometric survey data but can be used with a high degree of confidence for comparable segments of the U. S. civilian population.

APPENDIX A

COMPARISON OF PERCENTILES, SUBGROUP MEANS, AND REGRESSION MEANS FOR MALE AND FEMALE MILITARY POPULATIONS ESTABLISHED ON THE VARIABLES OF SITTING HEIGHT AND BODY WEIGHT

TABLE A-1

Comparison of 5th Percentile Values With Small-Short Sitting Heigh Subgroup Values and USAF-1967 Regression Values*

Variable	5%ile Population Value	Sm-Sh Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
Weight	140.2	135.0	-5.2	(3.7)	140.2	-	-
Height (Stature)	167.3	167.1	-0.2	(0.1)	168.6	1.3	(0.8)
Cervicale Height	142.5	142.4	-0.1	(0.1)	144.1	1.6	(1.1)
Acromion Height	135.7	135.7	-	-	137.3	1.6	(1.2)
Radiale Height	104.8	105.0	0.2	(0.2)	105.9	1.1	(1.0)
Stylion Height	80.2	80.5	0.3	(0.4)	81.4	1.2	(1.5)
Dactylion Height	61.5	62.1	0.6	(1.0)	62.8	1.3	(2.1)
Suprasternale Ht	136.3	136.1	-0.2	(0.1)	137.5	1.2	(0.9)
Nipple Height	120.8	121.4	0.6	(0.5)	122.6	1.8	(1.5)
Waist Ht-Omphalion	98.7	100.2	1.5	(1.5)	101.3	2.6	(2.6)
Iliocristale Ht	101.3	102.5	1.2	(1.2)	103.7	2.4	(2.4)
Buttock Height	83.1	84.9	1.8	(2.2)	85.8	2.7	(3.2)
Trochanterion Ht	86.9	88.6	1.7	(2.0)	89.7	2.8	(3.2)
Gluteal Furrow Ht	74.6	76.4	1.8	(2.4)	77.3	2.7	(3.6)
Crotch Height	78.3	80.7	2.4	(3.1)	81.4	3.1	(4.0)
Patella Top Height	48.5	49.5	1.0	(2.1)	50.1	1.6	(3.3)
Knee Circ Height	45.7	46.6	0.9	(2.0)	47.1	1.4	(3.1)
Fibular Height	40.2	41.2	1.0	(2.5)	41.7	1.5	(3.7)
Calf Height	32.0	33.3	1.3	(4.1)	33.6	1.6	(5.0)
Ankle Height	12.0	13.1	1.1	(9.2)	13.1	1.1	(9.2)
Sitting Height	88.1	87.5	-0.6	(0.7)	88.1	-	-
Eye Height/Sitting	76.1	75.9	-0.2	(0.3)	76.5	0.4	(0.5)
dshoulder Ht/Sit	60.2	59.8	-0.4	(0.7)	60.5	0.3	(0.5)
cromion Height/Sit	56.5	56.1	-0.4	(0.7)	57.0	0.5	(0.9)
Elbow Rest Ht/Sit	20.9	22.4	1.5	(7.2)	22.8	1.9	(9.1)
Knee Height/Sitting	51.7	52.3	0.6	(1.2)	52.9	1.2	(2.3)
Popliteal Ht/Sit	40.0	41.5	1.5	(3.8)	41.8	1.8	(4.5)
Buttock-Knee Length	56.0	56.7	0.7	(1.3)	57.4	1.4	(2.5)
Buttock-Popliteal	46.1	47.2	1.1	(2.4)	47.8	1.7	(3.7)
Shoulder-Elbow Lg	33.2	33.9	0.7	(2.1)	34.4	1.2	(3.6)
Acromion-Radiale Lg	30.2	30.9	0.7	(2.3)	31.4	1.2	(4.0)
Elbow-Wrist Length	27.7	28.4	0.7	(2.5)	28.7	1.0	(3.6)
Radiale-Stylion Lg	24.6	25.3	0.7	(2.8)	25.7	1.1	(4.5)
Elbow-Grip Length	32.6	33.3	0.7	(2.1)	33.7	1.1	(3.4)
Thumb-Tip Reach	73.9	76.5	2.6	(3.5)	76.7	2.8	(3.8)
Thumb-Tip Reach/Extd	82.3	85.4	3.1	(3.8)	85.8	3.5	(4.3)
Sleeve Inseam	44.4	46.1	1.7	(3.8)	46.7	2.3	(5.2)
Biacromial Breadth	37.5	38.7	1.2	(3.2)	39.0	1.5	(4.0)
Bideltoid Breadth	44.1	44.3	0.2	(0.5)	45.3	1.2	(2.7)
Chest Breadth	29.5	30.0	0.5	(1.7)	30.6	1.1	(3.7)
Waist Breadth-Omph	27.2	27.4	0.2	(0.7)	28.2	1.0	(3.7)
Hip Breadth	32.3	32.2	-0.1	(0.3)	32.9	0.6	(1.9)
Hip Breadth/Sitting	34.2	34.0	0.2	(0.6)	34.9	0.7	(2.0)
Elbow Breadth Bone/R	6.5	6.8	0.3	(4.6)	6.8	0.3	(4.6)
Forearm-Forearm Br	48.2	49.6	1.4	(2.9)	50.9	2.7	(5.6)
Knee Breadth Bone/R	9.3	9.4	0.1	(1.1)	9.4	0.1	(1.1)
Chest Depth	21.3	22.2	0.9	(4.2)	22.7	1.4	(6.6)
Waist Depth-Omph	18.9	19.6	0.7	(3.7)	20.3	1.4	(7.4)
uttock Depth	20.7	21.2	0.5	(2.4)	21.8	1.1	(5.3)
Thigh Clearance Ht	14.3	14.7	0.4	(2.8)	15.1	0.8	(5.6)

* Weight in pounds. All other measurement values in centimeters. Small-s sitting height subgroup n=58

Subgroup Values and USAF-1967 Regression Values*

Variable	5%ile Population Value	Sm-Sh Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
Neck Circ - Max	35.4	35.9	0.5	(1.4)	36.4	1.0	(2.8)
Shoulder Circ	108.4	108.5	0.1	(0.1)	110.7	2.3	(2.1)
Chest Circumference	88.6	90.1	1.5	(1.7)	91.8	3.2	(3.6)
Waist Circ-Omph	75.7	77.0	1.3	(1.7)	79.6	3.9	(5.2)
Waist Circ-Omph/Sit	75.4	77.2	1.8	(2.4)	79.8	4.4	(5.8)
Buttock Circ	89.7	89.4	-0.3	(0.3)	91.1	1.4	(1.6)
Buttock Circ/Sit	97.1	96.7	-0.4	(0.4)	99.0	1.9	(2.0)
Vertical Trunk Circ	156.7	153.7	-3.0	(1.9)	156.3	-0.4	(0.3)
Vert Trunk Circ/Sit	150.4	148.0	-2.4	(1.6)	150.2	-0.2	(0.1)
Upper Thigh Circ	51.5	52.4	0.9	(1.7)	53.6	2.1	(4.1)
Upper Thigh Circ/Sit	50.8	51.4	0.6	(1.2)	52.7	1.9	(3.7)
Knee Circumference	35.4	35.3	-0.1	(0.3)	35.9	0.5	(1.4)
Knee Circ/Sitting	36.0	36.1	0.1	(0.3)	36.5	0.5	(1.4)
Calf Circ/Right	33.5	34.0	0.5	(1.5)	34.7	1.2	(3.6)
Ankle Circumference	20.4	20.8	0.4	(2.0)	21.0	0.6	(2.9)
Scye Circumference	43.8	44.1	0.3	(0.7)	45.2	1.4	(3.2)
Biceps Circ/Extd/R	27.0	27.8	0.8	(3.0)	28.3	1.3	(4.8)
Biceps Circ/Flexd/R	29.1	29.8	0.7	(2.4)	30.4	1.3	(4.5)
Elbow Circ-Extended	25.4	25.6	0.2	(0.8)	25.9	0.5	(2.0)
Elbow Circ-Flexed	28.5	29.1	0.6	(2.1)	29.5	1.0	(3.5)
Lower Arm Circ/Flexd	27.2	27.7	0.5	(1.8)	28.0	0.8	(2.9)
Wrist Circumference	16.2	16.5	0.3	(1.9)	16.7	0.5	(3.1)
Sleeve Lg/Spine-Scye	25.5	26.5	1.0	(3.9)	26.9	1.4	(5.5)
Sleeve L/Spine-Elbow	56.4	56.9	0.5	(0.9)	57.7	1.3	(2.3)
Sleeve L/Spine-Wrist	85.2	85.6	0.4	(0.5)	86.7	1.5	(1.8)
Shoulder Length	14.6	15.7	1.1	(7.5)	15.8	1.2	(8.2)
Interscye	32.5	36.9	4.4	(13.5)	36.9	4.4	(13.5)
Interscye Maximum	56.6	57.0	0.4	(0.7)	58.1	1.5	(2.7)
Waist Front-Omph	36.9	37.5	0.6	(1.6)	37.8	0.9	(2.4)
Crotch Lg-Omphalion	63.6	64.0	0.4	(0.6)	65.1	1.5	(2.4)
Waist Back-Omphalion	43.1	43.5	0.4	(0.9)	44.1	1.0	(2.3)
Foot Length	25.1	25.7	0.6	(2.4)	25.8	0.7	(2.8)
Foot Breadth	9.0	9.3	0.3	(3.3)	9.3	0.3	(3.3)
Ball-of-Foot Circ	22.9	23.4	0.5	(2.2)	23.6	0.7	(3.1)
Bi-Malleolar Br	6.7	6.9	0.2	(3.0)	7.0	0.3	(4.5)
Lateral Malleolus Ht	6.2	6.6	0.4	(6.5)	6.7	0.5	(8.1)
Medial Malleolus Ht	7.6	8.0	0.4	(5.3)	8.1	0.5	(6.6)
Hand Length	17.8	18.2	0.4	(2.2)	18.4	0.6	(3.4)
Palm Length	10.0	10.3	0.3	(3.0)	10.4	0.4	(4.0)
Hand Br/Metacarpale	8.2	8.5	0.3	(3.7)	8.5	0.3	(3.7)
Hand C/Metacarpale	20.0	20.6	0.6	(3.0)	20.7	0.7	(3.5)
Hand Thick/Meta-3	2.4	2.7	0.3	(12.5)	2.7	0.3	(12.5)
Head Circumference	55.2	56.1	0.9	(1.6)	56.4	1.2	(2.2)
Head Length	18.8	19.4	0.6	(3.2)	19.5	0.7	(3.7)
Head Breadth	14.7	15.3	0.6	(4.1)	15.3	0.6	(4.1)

* Weight in pounds. All other measurement values in centimeters. Small-shor sitting height subgroup n=58.

Subgroup Values and USAF-1967 Regression Values*

riable	95%ile Population Value	Large-Long Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ight	210.8	215.9	5.1	(2.4)	210.8	-	-
ight (Stature)	187.7	187.6	-0.1	(0.1)	186.8	-0.9	(0.5)
rvicale Height	161.8	161.3	-0.5	(0.3)	160.7	-1.1	(0.7)
romion Height	154.8	154.5	-0.3	(0.2)	153.8	-1.0	(0.6)
diale Height	120.0	119.6	-0.4	(0.3)	119.2	-0.8	(0.7)
ylion Height	93.3	92.6	-0.7	(0.8)	92.2	-1.1	(1.2)
ctylion Height	73.2	72.1	-1.1	(1.5)	71.9	-1.3	(1.8)
prasternale Ht	154.5	154.2	-0.3	(0.2)	153.5	-1.0	(0.6)
pple Height	138.1	137.1	-1.0	(0.7)	136.4	-1.7	(1.2)
ist Ht-Omphalion	114.3	112.3	-2.0	(1.7)	112.1	-2.2	(1.9)
iocristale Ht	117.2	115.3	-1.9	(1.6)	115.1	-2.1	(1.8)
ttock Height	97.5	95.3	-2.2	(2.3)	94.9	-2.6	(2.7)
ochanterion Ht	101.3	98.7	-2.6	(2.6)	98.6	-2.7	(2.7)
uteal Furrow Ht	87.9	85.6	-2.3	(2.6)	85.2	-2.7	(3.1)
otch Height	92.0	89.2	-2.8	(3.0)	89.1	-2.9	(3.2)
tella Top Height	56.9	55.6	-1.3	(2.3)	55.4	-1.5	(2.6)
ee Circ Height	53.9	52.5	-1.4	(2.6)	52.4	-1.5	(2.8)
bular Height	47.6	46.4	-1.2	(2.5)	46.3	-1.3	(2.7)
lf Height	39.3	38.1	-1.2	(3.1)	37.7	-1.6	(4.1)
kle Height	15.8	14.3	-1.5	(9.5)	14.4	-1.4	(8.9)
tting Height	98.6	99.3	0.7	(0.7)	98.6	-	-
e Height/Sitting	86.1	86.5	0.4	(0.5)	85.7	-0.4	(0.5)
dshoulder Ht/Sitting	69.2	69.5	0.3	(0.4)	69.0	-0.2	(0.3)
romion Ht/Sitting	65.9	65.9	-	-	65.4	-0.5	(0.6)
bow Rest Ht/Sitting	29.5	27.9	-1.6	(5.4)	27.7	-1.8	(6.1)
ee Height/Sitting	59.9	59.1	-0.8	(1.3)	58.9	-1.0	(1.9)
pliteal Ht/Sitting	47.5	46.0	-1.5	(3.2)	45.8	-1.7	(3.6)
ttock-Knee Length	65.0	63.7	-1.3	(2.0)	63.7	-1.3	(2.0)
ttock-Popliteal	54.6	53.2	-1.4	(2.6)	53.2	-1.4	(2.6)
oulder-Elbow Length	38.8	38.0	-0.8	(2.1)	37.7	-1.1	(2.8)
romion-Radiale Lg	35.8	34.9	-0.9	(2.5)	34.6	-0.8	(2.2)
bow-Wrist Length	32.4	31.4	-1.0	(3.1)	31.4	-1.0	(3.1)
diale-Stylion Lg	29.2	28.3	-0.9	(3.1)	28.2	-1.0	(3.4)
bow-Grip Length	37.9	36.9	-1.0	(2.6)	36.9	-1.0	(2.6)
umb-Tip Reach	87.0	84.8	-2.2	(2.5)	84.2	-2.8	(3.2)
umb-Tip R'ch Extended	97.3	94.7	-2.6	(2.7)	93.7	-3.6	(3.7)
eeve Inseam	52.8	50.8	-2.0	(3.8)	50.6	-2.2	(4.2)
acromial Breadth	43.8	42.8	-1.0	(2.3)	42.6	-1.2	(2.7)
deltoid Breadth	52.6	51.9	-0.7	(1.3)	51.5	-1.1	(2.1)
est Breadth	36.5	35.4	-1.1	(3.0)	35.2	-1.3	(3.6)
ist Breadth-Omphalion	35.0	34.2	-0.8	(2.3)	34.0	-1.0	(2.9)
p Breadth	38.5	38.0	-0.5	(1.3)	37.9	-0.6	(1.6)
p Breadth/Sitting	41.8	41.1	-0.7	(1.7)	41.1	-0.7	(1.7)
bow Breadth Bone/R	7.7	7.5	-0.2	(2.6)	7.4	-0.3	(3.9)
rearm-Forearm Breadth	60.7	58.6	-2.1	(3.5)	58.2	-2.5	(4.1)
ee Breadth Bone/R	10.7	10.6	-0.1	(0.9)	10.6	-0.1	(0.9)
est Depth	27.7	26.7	-1.0	(3.6)	26.6	-1.1	(4.0)
ist Depth-Omphalion	26.1	24.7	-1.4	(5.4)	24.6	-1.5	(5.7)
ttock Depth	27.5	26.4	-1.1	(4.0)	26.5	-1.0	(3.6)
igh Clearance Height	18.8	18.3	-0.5	(2.7)	18.2	-0.6	(3.2)

Weight in pounds. All other measurement values in centimeters. Large-long sitting height subgroup n=80.

Subgroup Values and USAF 1967 Regression Values*

riable	95%ile Population Value	Large-Long Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ck Circ Maximum	41.6	40.9	-0.7	(1.7)	40.5	-1.1	(2.6)
oulder Circ	127.6	126.2	-1.4	(1.1)	125.5	-2.1	(1.6)
est Circumference	109.4	106.6	-2.8	(2.6)	106.2	-3.2	(2.9)
ist Circ-Omphalion	100.1	97.2	-2.9	(2.9)	96.7	-3.4	(3.4)
ist Circ-Omph/Sit	100.2	96.0	-4.2	(4.2)	96.0	-4.2	(4.2)
ttock Circumference	107.9	107.3	-0.6	(0.6)	107.0	-0.9	(0.8)
ttock Circ/Sitting	119.3	117.8	-1.5	(1.3)	117.2	-2.1	(1.8)
rtical Trunk Circ	180.2	182.1	1.9	(1.1)	180.9	0.7	(0.4)
rt Trunk Circ/Sit	173.2	174.4	1.2	(0.7)	173.4	0.2	(0.1)
per Thigh Circ	66.2	65.0	-1.2	(1.8)	64.6	-1.6	(2.4)
per Thigh Circ/Sit	65.0	64.1	-0.9	(1.4)	63.7	-1.3	(2.0)
ee Circumference	42.2	41.9	-0.3	(0.7)	41.7	-0.5	(1.2)
ee Circ/Sitting	43.0	42.6	-0.4	(0.9)	42.4	-0.6	(1.4)
lf Circ/Right	41.0	40.1	-0.9	(2.2)	40.0	-1.0	(2.4)
kle Circumference	24.6	24.0	-0.6	(2.4)	24.0	-0.6	(2.4)
ye Circumference	53.0	51.8	-1.2	(2.3)	51.9	-1.1	(2.1)
ceps Circ/Extended/R	34.7	33.9	-0.8	(2.3)	33.5	-1.2	(3.5)
ceps Circ/Flexed/R	36.6	35.8	-0.8	(2.2)	35.4	-1.2	(3.3)
bow Circ-Extended	30.1	29.8	-0.3	(1.0)	29.6	-0.5	(1.7)
bow Circ-Flexed	34.2	33.4	-0.8	(2.3)	33.1	-1.1	(3.2)
wer Arm Circ-Flexed	32.4	32.0	-0.4	(1.2)	31.7	-0.7	(2.2)
ist Circumference	19.2	18.8	-0.4	(2.1)	18.6	-0.6	(3.1)
eeve L/Spine-Scye	31.5	30.5	-1.0	(3.2)	30.2	-1.3	(4.1)
eeve L/Spine-Elbow	65.0	64.4	-0.6	(0.9)	63.8	-1.2	(1.8)
eeve L/Spine-Wrist	96.8	96.0	-0.8	(0.8)	95.4	-1.4	(1.4)
oulder Length	18.7	17.5	-1.2	(6.4)	17.5	-1.2	(6.4)
terscye	45.0	40.7	-4.3	(9.6)	40.9	-4.1	(9.1)
terscye Maximum	66.6	65.5	-1.1	(1.7)	65.4	-1.2	(1.8)
ist Front-Omphalion	44.2	43.8	-0.4	(0.9)	43.2	-1.0	(2.3)
otch Length-Omphalion	78.2	76.8	-1.4	(1.8)	76.7	-1.5	(1.9)
ist Back-Omphalion	50.9	50.2	-0.7	(1.4)	49.9	-1.0	(2.0)
ot Length	29.0	28.6	-0.4	(1.4)	28.4	-0.6	(2.1)
ot Breadth	10.6	10.4	-0.2	(1.9)	10.3	-0.3	(2.8)
ll-of-Foot Circ	27.0	26.4	-0.6	(2.2)	26.2	-0.8	(3.0)
-Malleolar Breadth	8.0	7.7	-0.3	(3.8)	7.7	-0.3	(3.8)
teral Malleolus Ht	8.0	7.5	-0.5	(6.3)	7.5	-0.5	(6.3)
dial Malleolus Ht	9.5	9.2	-0.3	(3.2)	9.1	-0.4	(4.2)
nd Length	20.5	20.0	-0.5	(2.4)	19.9	-0.6	(2.9)
lm Length	11.7	11.3	-0.4	(3.4)	11.3	-0.4	(3.4)
nd Br/Metacarple	9.6	9.4	-0.2	(2.1)	9.3	-0.3	(3.1)
nd Circ/Metacarpale	23.1	22.7	-0.4	(1.7)	22.5	-0.6	(2.6)
nd Thick/Meta-3	3.1	2.9	-0.2	(6.5)	2.9	-0.2	(6.4)
ad Circumference	59.9	58.8	-1.1	(1.8)	58.7	-1.2	(2.0)
ad Length	21.0	20.3	-0.7	(3.3)	20.3	-0.7	(3.3)
ad Breadth	16.5	15.9	-0.6	(3.6)	15.9	-0.6	(3.6)

Weight in pounds. All other measurement values in centimeters. Large-long sitting height subgroup n=80.

Comparison of 5th Percentile Values With Small-Short Sitting Height Subgroup Values and WAF-1968 Regression Values*

riable	5%ile Population Value	Sm-Sh Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ight	102.3	100.5	-1.8	(1.8)	102.3	-	-
ature	152.4	152.5	0.1	(0.7)	153.4	1.0	(0.7)
ature, Maximum	152.9	153.1	0.2	(0.1)	154.0	1.1	(0.7)
rvicale Height	130.3	130.6	0.3	(0.2)	131.5	1.2	(0.9)
romial Height	123.0	123.1	0.1	(0.1)	124.3	1.3	(1.1)
prasternale Ht	123.4	123.6	0.2	(0.2)	124.6	1.2	(1.0)
st Point Height	110.0	110.8	0.8	(0.7)	111.9	1.9	(1.7)
ist Height	93.1	94.4	1.3	(1.4)	95.0	1.9	(2.0)
dominal Ext Ht	86.1	87.8	1.7	(2.0)	88.5	2.4	(2.8)
ochanteric Ht	75.7	77.6	1.9	(2.5)	78.3	2.6	(3.4)
ttock Height	75.4	77.8	2.4	(3.2)	78.0	2.6	(3.4)
uteal Furrow Ht	66.4	68.8	2.4	(3.6)	69.3	2.9	(4.5)
biale Height	38.2	39.5	1.3	(3.4)	39.8	1.6	(4.2)
otch Height	68.1	70.2	2.1	(3.1)	70.7	2.6	(3.8)
kle Height	9.2	10.6	1.4	(15.2)	10.7	1.5	(16.3)
teral Malleolus Ht	5.8	6.3	0.5	(8.6)	6.4	0.6	(10.3)
tting Ht, Relaxed	78.9	78.6	-0.3	(0.4)	79.2	0.3	(0.4)
tting Height	80.4	79.7	-0.7	(0.9)	80.4	-	-
e Height, Sitting	68.7	68.4	-0.3	(0.4)	69.1	0.4	(0.6)
dshoulder Ht, Sit	53.7	53.3	-0.4	(0.7)	54.0	0.3	(0.6)
ist Ht, Sitting	20.5	21.3	0.8	(3.9)	21.6	1.1	(5.4)
bow Rest Height	18.7	20.2	1.5	(8.0)	20.8	2.1	(11.2)
pliteal Height	38.0	39.6	1.6	(4.2)	39.5	1.5	(4.0)
ttock-Popliteal L	43.5	45.1	1.6	(3.7)	45.2	1.7	(3.9)
ttock-Knee Length	53.2	54.0	0.8	(1.5)	54.4	1.2	(2.3)
romion-Radiale Lgth	28.3	29.5	1.2	(4.2)	29.5	1.2	(4.2)
diale-Stylion Lgth	21.2	22.2	1.0	(4.7)	22.3	1.1	(5.2)
umb-Tip Reach	67.7	70.9	3.2	(4.7)	70.8	3.1	(4.6)
umb-Tip, Extended	76.0	79.6	3.6	(4.7)	79.5	3.5	(4.6)
erhead Reach	185.2	188.0	2.8	(1.5)	189.1	3.9	(2.1)
ck Circumference	31.1	32.1	1.0	(3.2)	32.2	1.1	(3.5)
oulder Circ	92.6	93.8	1.2	(1.3)	94.5	1.9	(2.1)
est Circ at Scye	77.0	78.3	1.3	(1.7)	78.9	1.9	(2.5)
st Circumference	81.6	83.6	2.0	(2.5)	83.8	2.2	(2.7)
est Circ Below Bust	67.2	68.7	1.5	(2.2)	69.2	2.0	(3.0)
ist Circumference	59.5	61.1	1.6	(2.7)	61.4	1.9	(3.2)
dominal Ext Circ	74.8	77.6	2.8	(3.7)	78.1	3.3	(4.4)
p C-7" Below Waist	85.1	85.3	0.2	(0.2)	86.7	1.6	(1.9)
p C-9" Below Waist	85.8	85.8	-	-	87.6	1.8	(2.1)
per Thigh Circ	48.7	49.7	1.0	(2.1)	50.8	2.1	(4.3)
ee Circumference	32.8	33.1	0.3	(0.9)	33.6	0.8	(2.4)
lf Circ, Right	30.6	31.3	0.7	(2.3)	31.7	1.1	(3.6)
kle Circumference	19.0	19.6	0.6	(3.2)	19.8	0.8	(4.2)
rtical Trunk Circ	143.5	142.2	-1.3	(0.9)	143.6	0.1	(0.1)
rt Trunk Circ, Sit	139.4	137.9	-1.5	(1.1)	139.6	0.2	(0.1)
ttock Circ, Sit	90.9	90.8	-0.1	(0.1)	92.1	1.2	(1.3)
ye Circumference	33.6	34.3	0.7	(2.1)	34.5	0.9	(2.7)
illary Arm Circ	23.9	24.9	1.0	(4.2)	25.1	1.2	(5.0)
ceps C, Relaxed, R	22.2	23.1	0.9	(4.1)	23.4	1.2	(5.4)
ceps C, Flexed, R	23.3	24.2	0.9	(3.9)	24.5	1.2	(5.2)

Weight in pounds. All other measurement values in centimeters. Small-short sitting height subgroup n=49.

Subgroup Values and WAF-1988 Regression Values*

iable	5%ile Population Value	Sm-Sh Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ow Circ, Flexed	24.2	25.0	0.8	(3.3)	25.3	1.1	(4.5)
earm C, Relaxed	21.3	21.7	0.4	(1.9)	22.0	0.7	(3.3)
earm C, Flexed	22.6	23.1	0.5	(2.2)	23.3	0.7	(3.1)
st Circumference	13.8	14.1	0.3	(2.2)	14.2	0.4	(2.9)
cromial Breadth	33.2	34.2	1.0	(3.0)	34.3	1.1	(3.3)
eltoid Breadth	38.2	38.9	0.7	(1.8)	39.4	1.2	(3.1)
st Breadth	25.1	25.8	0.7	(2.8)	26.1	1.0	(4.0)
t Pt-Bust Pt Br	16.1	17.3	1.2	(7.5)	17.4	1.3	(8.0)
st Breadth	21.2	22.0	0.8	(3.8)	22.1	0.9	(4.2)
Breadth	31.6	32.0	0.4	(1.3)	32.4	0.8	(2.5)
gh-Thigh Br, Sit	33.8	34.4	0.6	(1.8)	35.1	1.3	(3.8)
eral Breadth, R	5.6	5.8	0.2	(3.6)	5.8	0.2	(3.6)
oral Breadth, R	7.4	7.7	0.3	(4.1)	7.7	0.3	(4.1)
st Depth	20.9	21.9	1.0	(4.8)	21.9	1.0	(4.8)
st Depth	14.8	15.3	0.5	(3.4)	15.5	0.7	(4.7)
ominal Ext Depth	17.9	18.7	0.8	(4.5)	18.9	1.0	(5.6)
tock Depth	18.4	19.0	0.6	(3.3)	19.3	0.9	(4.9)
gh Clearance	10.4	10.8	0.4	(3.8)	11.1	0.7	(6.7)
ulder Length	13.0	13.9	0.9	(6.9)	14.0	1.0	(7.7)
k-Bust Point Lgth	22.5	24.1	1.6	(7.1)	23.8	1.3	(5.8)
ap Length	59.2	61.6	2.4	(4.1)	61.2	2.0	(3.4)
erscye	31.2	32.5	1.3	(4.2)	33.3	2.1	(6.7)
erscye, Maximum	43.9	45.5	1.6	(3.6)	46.5	2.6	(5.9)
k Curvature	37.6	39.0	1.4	(3.7)	39.6	2.0	(5.3)
st Back	37.0	37.8	0.8	(2.2)	38.2	1.2	(3.2)
erior Waist Lgth	30.5	31.3	0.8	(2.6)	31.5	1.0	(3.3)
eve Inseam	40.2	42.3	2.1	(5.2)	42.4	2.2	(5.5)
ne-To-Scye Lgth	18.3	19.6	1.3	(7.1)	19.4	1.1	(6.0)
ne-To-Elbow Lgth	49.4	50.2	0.8	(1.6)	50.6	1.2	(2.4)
ne-To-Wrist Lgth	74.2	75.5	1.3	(1.8)	75.9	1.7	(2.3)
d Length	16.9	17.8	0.9	(5.3)	17.6	0.7	(4.1)
d Breadth	6.9	7.2	0.3	(4.3)	7.3	0.4	(5.8)
d Circumference	16.8	17.5	0.7	(4.2)	17.6	0.8	(4.8)
t Length	22.2	22.7	0.5	(2.3)	22.9	0.7	(3.2)
t Breadth	8.0	8.6	0.6	(7.5)	8.5	0.5	(6.3)
d Length	17.3	18.0	0.7	(4.0)	18.0	0.7	(4.0)
d Breadth	13.5	14.1	0.6	(4.4)	14.3	0.8	(5.9)
d Circumference	52.3	53.4	1.1	(2.1)	53.7	1.4	(2.7)

eight in pounds. All other measurement values in centimeters. Small-short itting height subgroup n=49.

Comparison of 95th Percentile Values With Large-Long Sitting Height Subgroup Values and WAF-1968 Regression Values*

iable	95%ile Population Value	Lg-L Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ght	156.4	161.2	4.8	(3.1)	156.4	-	-
ture	172.2	171.7	-0.5	(0.3)	171.2	-1.0	(0.6)
ture, Maximum	172.8	172.5	-0.3	(0.2)	171.9	-0.9	(0.5)
vicale Height	148.4	147.9	-0.5	(0.3)	147.4	-1.0	(0.7)
omial Height	141.1	140.5	-0.6	(0.4)	139.9	-1.2	(0.9)
rasternale Ht	140.9	140.3	-0.6	(0.4)	139.9	-1.0	(0.7)
t Point Height	127.3	125.0	-2.3	(1.8)	125.0	-2.3	(1.8)
st Height	107.9	106.4	-1.5	(1.4)	106.0	-1.9	(1.8)
ominal Ext Ht	100.7	98.2	-2.5	(2.5)	98.2	-2.5	(2.5)
chanteric Ht	89.8	87.5	-2.3	(2.6)	87.4	-2.3	(2.6)
tock Height	89.2	86.9	-2.3	(2.6)	86.8	-2.4	(2.7)
teal Furrow Ht	79.4	76.6	-2.8	(3.5)	76.4	-3.0	(3.8)
iale Height	46.1	44.6	-1.5	(3.3)	44.3	-1.8	(3.9)
tch Height	81.4	78.9	-2.5	(3.1)	78.7	-2.7	(3.3)
le Height	13.6	11.9	-1.7	(12.5)	11.8	-1.8	(13.2)
eral Malleolus Ht	7.8	7.2	-0.6	(7.7)	7.2	-0.6	(7.7)
ting Ht, Relaxed	89.7	90.2	0.5	(0.6)	89.5	-0.2	(0.2)
ting Height	90.9	91.9	1.0	(1.1)	90.9	-	-
Height, Sitting	78.8	79.5	0.7	(0.9)	78.4	-0.4	(0.5)
shoulder Ht, Sit	62.5	63.1	0.6	(1.0)	62.2	-0.3	(0.5)
st Ht, Sitting	26.2	25.9	-0.3	(1.1)	25.2	-1.0	(3.8)
ow Rest Height	26.9	25.0	-1.9	(7.1)	24.6	-2.3	(8.6)
liteal Height	44.1	42.8	-1.3	(2.9)	42.7	-1.4	(3.2)
tock-Popliteal L	52.6	50.6	-2.0	(3.8)	50.6	-2.0	(3.8)
tock-Knee Length	61.9	60.9	-1.0	(1.6)	60.9	-1.0	(1.6)
omion-Radiale Lgth	33.6	32.9	-0.7	(2.1)	32.7	-0.9	(2.7)
liale-Stylion Lgth	25.7	24.7	-1.0	(3.9)	24.6	-1.1	(4.3)
mb-Tip Reach	80.5	77.6	-2.9	(3.6)	77.8	-2.7	(3.4)
mb-Tip, Extended	92.3	88.4	-3.9	(4.2)	88.6	-3.7	(4.0)
rhead Reach	213.3	209.2	-4.1	(1.9)	210.0	-3.3	(1.6)
k Circumference	36.7	35.9	-0.8	(2.2)	35.5	-1.2	(3.3)
ulder Circ	109.4	107.9	-1.5	(1.4)	107.4	-2.0	(1.8)
st Circ at Scye	93.2	91.5	-1.7	(1.8)	90.7	-2.5	(2.7)
st Circumference	100.2	97.5	-2.7	(2.7)	96.8	-3.4	(3.4)
st Circ Below Bust	83.1	80.6	-2.5	(3.0)	80.5	-2.6	(3.1)
ist Circumference	77.2	75.1	-2.1	(2.7)	74.2	-3.0	(3.9)
lominal Ext Circ	98.6	95.9	-2.7	(2.7)	94.7	-3.9	(4.0)
C-7" Below Waist	103.3	102.3	-1.0	(1.0)	101.9	-1.4	(1.4)
C-9" Below Waist	105.6	104.8	-0.8	(0.8)	104.3	-1.3	(1.2)
er Thigh Circ	62.6	61.7	-0.9	(1.4)	61.1	-1.5	(2.4)
e Circumference	40.2	39.7	-0.5	(1.2)	39.5	-0.7	(1.7)
lf Circ, Right	37.9	36.9	-1.0	(2.6)	37.0	-0.9	(2.4)
kle Circumference	23.3	22.6	-0.7	(3.0)	22.6	-0.7	(3.0)
rtical Trunk Circ	166.3	167.5	1.2	(0.7)	166.3	-	-
rt Trunk Circ, Sit	161.0	162.6	1.6	(1.0)	161.5	0.5	(0.3)
tock Circ, Sit	110.8	110.3	-0.5	(0.5)	109.3	-1.5	(1.4)
ve Circumference	41.1	40.3	-0.8	(1.9)	40.1	-1.0	(2.4)
illary Arm Circ	31.5	30.8	-0.7	(2.2)	30.2	-1.3	(4.1)
ceps C, Relaxed, R	29.7	28.5	-1.2	(4.0)	28.3	-1.4	(4.7)
ceps C, Flexed, R	30.8	29.7	-1.1	(3.6)	29.6	-1.2	(3.9)

Weight in pounds. All other measurement values in centimeters. Large-long sitting height subgroup n=51.

Subgroup Values and WAF-1968 Regression Values*

iable	95%ile Population Value	Large-Long Sit-Ht Subgroup Mean	Δ	(Δ%)	Population Regression Mean	Δ	(Δ%)
ow Circ, Flexed	30.0	29.0	-1.0	(3.3)	28.9	-1.1	(3.7)
earm C, .Relaxed	25.8	25.5	-0.3	(1.2)	25.3	-0.5	(1.9)
earm C, Flexed	27.5	27.1	-0.4	(1.5)	26.9	-0.6	(2.2)
st Circumference	16.2	16.0	-0.2	(1.2)	15.9	-0.3	(1.9)
cromial Breadth	38.6	37.6	-1.0	(2.6)	37.5	-1.1	(2.8)
eltoid Breadth	45.9	45.2	-0.7	(1.5)	44.9	-1.0	(2.2)
st Breadth	31.4	30.3	-1.1	(3.5)	30.2	-1.2	(3.8)
t Pt-Bust Pt Br	21.2	19.9	-1.3	(6.1)	19.9	-1.3	(6.1)
ist Breadth	27.6	26.5	-1.1	(4.0)	26.5	-1.1	(4.0)
Breadth	38.8	38.3	-0.5	(1.3)	38.0	-0.8	(2.1)
igh-Thigh Br, Sit	43.3	42.6	-0.7	(1.6)	41.9	-1.4	(3.2)
eral Breadth, R	6.7	6.5	-0.2	(3.0)	6.5	-0.2	(3.0)
oral Breadth, R	8.9	8.6	-0.3	(3.4)	8.5	-0.4	(4.5)
st Depth	27.2	26.2	-1.0	(3.7)	25.8	-1.4	(5.1)
st Depth	20.2	19.1	-1.1	(5.4)	18.9	-1.3	(6.4)
lominal Ext Depth	24.8	23.6	-1.2	(4.8)	23.4	-1.4	(5.6)
tock Depth	24.3	23.6	-0.7	(2.9)	23.4	-0.9	(3.7)
gh Clearance	14.6	14.1	-0.5	(3.4)	14.0	-0.6	(4.1)
ulder Length	16.4	15.3	-1.1	(6.7)	15.3	-1.1	(6.7)
k-Bust Point Lgth	28.8	28.0	-0.8	(2.8)	27.4	-1.4	(4.9)
ap Length	72.1	70.9	-1.2	(1.7)	69.9	-2.2	(3.1)
erscye	39.2	37.2	-2.0	(5.1)	37.2	-2.0	(5.1)
erscye, Maximum	54.7	53.3	-1.4	(2.6)	52.8	-1.9	(3.5)
k Curvature	47.6	45.5	-2.1	(4.4)	45.2	-2.4	(5.0)
ist Back	44.3	42.9	-1.4	(3.2)	42.9	-1.4	(3.2)
erior Waist Lgth	36.9	35.9	-1.0	(2.7)	35.8	-1.1	(3.0)
eve Inseam	48.2	45.8	-2.4	(5.0)	46.0	-2.2	(4.6)
ine-To-Scye Lgth	22.7	21.6	-1.1	(4.8)	21.4	-1.3	(5.7)
ine-To-Elbow Lgth	57.3	56.4	-0.9	(1.6)	56.3	-1.0	(1.7)
ine-To-Wrist Lgth	85.1	83.9	-1.2	(1.4)	83.7	-1.4	(1.6)
nd Length	20.1	19.3	-0.8	(4.0)	19.3	-0.8	(4.0)
nd Breadth	8.2	7.9	-0.3	(3.7)	7.9	-0.3	(3.7)
nd Circumference	19.8	19.2	-0.6	(3.0)	19.2	-0.6	(3.0)
ot Length	26.0	25.4	-0.6	(2.3)	25.4	-0.6	(2.3)
ot Breadth	9.8	9.2	-0.6	(6.1)	9.3	-0.5	(5.1)
id Length	19.5	18.8	-0.7	(3.6)	18.9	-0.6	(3.1)
id Breadth	15.5	14.8	-0.7	(4.5)	14.8	-0.7	(4.5)
id Circumference	57.6	56.1	-1.5	(2.6)	56.2	-1.4	(2.4)

Weight in pounds. All other measurement values in centimeters. Large-long sitting height subgroup n=51.

APPENDIX B

MULTIPLE REGRESSION EQUATIONS FOR PREDICTING MALE AND FEMALE ANTHROPOMETRY FROM BODY WEIGHT AND STATURE

MULTIPLE REGRESSION EQUATION FOR PREDICTING MENS ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND STATURE*

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS STATURE IN MM					SY EST
WEIGHT	1.000	1.000*WT	+0.000*HT	+	0.00		0.00
HEIGHT (STATURE)	1.000	0.000*WT	+1.000*HT	+	0.00		0.00
CERVICALE HEIGHT	.977	.097*WT	+ .902*HT	-	96.60		12.30
ACROMION HEIGHT	.961	.221*WT	+ .853*HT	-	98.24		15.96
RADIALE HEIGHT	.924	.254*WT	+ .634*HT	-	45.58		17.41
STYLION HEIGHT	.843	.199*WT	+ .499*HT	-	53.72		21.21
DACTYLION HEIGHT	.775	.185*WT	+ .405*HT	-	78.25		22.19
SUPRASTERNALE HGHT	.976	.187*WT	+ .833*HT	-	58.05		11.90
NIPPLE HEIGHT	.949	-.019*WT	+ .806*HT	-	134.14		16.52
WAIST HT-OMPHALION	.925	-.159*WT	+ .733*HT	-	207.06		17.90
ILIOCRISTALE HT	.914	.107*WT	+ .690*HT	-	150.79		19.50
BUTTOCK HEIGHT	.870	.081*WT	+ .617*HT	-	193.66		21.65
TROCHANTERION HGHT	.887	-.100*WT	+ .642*HT	-	181.04		20.07
GLUTEAL FURROW HGT	.879	-.113*WT	+ .589*HT	-	213.92		19.13
CROTCH HEIGHT	.861	-.216*WT	+ .613*HT	-	199.35		21.05
PATELLA TOP HEIGHT	.855	.010*WT	+ .362*HT	-	99.19		13.25
KNEE CIRC HEIGHT	.859	.019*WT	+ .342*HT	-	113.87		12.74
FIBULAR HEIGHT	.845	-.012*WT	+ .310*HT	-	109.53		12.03
CALF HEIGHT	.747	.028*WT	+ .204*HT	-	117.62		14.77
ANKLE HEIGHT	.472	-.026*WT	+ .092*HT	-	21.66		10.13
SITTING HEIGHT	.739	.104*WT	+ .385*HT	+	230.63		19.50
EYE HEIGHT/SITTING	.739	.061*WT	+ .349*HT	+	179.71		20.31
MIDSHOULDER HT/SIT	.715	.260*WT	+ .251*HT	+	137.25		19.16
ACROMION HEIGHT/SIT	.656	.284*WT	+ .245*HT	+	126.35		21.29
ELBOW REST HGT/SIT	.272	.280*WT	+ .029*HT	+	151.02		25.09
KNEE HEIGHT/SITTING	.387	.133*WT	+ .332*HT	-	54.15		11.48
POPLITEAL HGHT/SIT	.355	-.191*WT	+ .339*HT	-	131.32		11.62
BUTTOCK-KNEE LNGTH	.812	.419*WT	+ .257*HT	+	75.10		15.74
BUTTOCK-POPLITEAL	.729	.347*WT	+ .224*HT	+	46.54		17.51
SHOULDER-ELBOW LTH	.753	.013*WT	+ .297*HT	-	9.04		11.26
ACROMION-RADIALE L	.720	.018*WT	+ .195*HT	-	19.38		11.81
ELBOW-WRIST LENGTH	.738	.031*WT	+ .163*HT	+	6.35		9.51
RADIALE-STYLION LH	.703	.034*WT	+ .155*HT	-	12.64		10.11
ELBOW-GRIP LENGTH	.753	.021*WT	+ .193*HT	+	5.85		10.61
THUMB-TIP REACH	.688	.156*WT	+ .406*HT	+	55.14		29.14
THUMB-TIP REACH/XTD	.640	.155*WT	+ .433*HT	+	91.87		34.69
SLEEVE INSEAM	.719	-.145*WT	+ .322*HT	-	59.99		17.83
BIACROMIAL BREADTH	.482	.317*WT	+ .062*HT	+	242.10		17.01
BIDELTOID BREADTH	.805	1.042*WT	- .061*HT	+	409.86		15.17
CHEST BREADTH	.764	.829*WT	- .059*HT	+	267.91		13.69
WAIST BRDTH-OMPH'N	.870	1.065*WT	- .080*HT	+	265.84		11.76
HIP BREADTH	.809	.714*WT	- .001*HT	+	230.82		11.06
HIP BREADTH SITTING	.859	.970*WT	- .035*HT	+	271.33		11.79
ELBOW BRDTH BONE/R	.595	.052*WT	+ .016*HT	+	33.38		3.12
FOREARM-FOREARM BRDTH	.729	1.443*WT	- .134*HT	+	530.88		25.90
KNEE BRDTH BONE/R	.544	.111*WT	+ .013*HT	+	58.53		3.44
CHEST DEPTH	.792	.805*WT	- .082*HT	+	251.73		11.74
WAIST DEPTH-OMPH'N	.695	.940*WT	- .116*HT	+	264.98		12.91
BUTTOCK DEPTH	.851	.922*WT	- .094*HT	+	247.30		10.77
THIGH CLEARANCE HT	.821	.603*WT	- .070*HT	+	104.85		7.88

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING MENS ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND STATURE*

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS STATURE IN MM	SE EST
NECK CIRC -MAXIMUM	.719	.715*WT - .061*HT + 366.93	13.29
SHOULDER CIRCUM"CE	.841	2.463*WT - .142*HT + 1000.43	31.45
CHEST CIRCUMF"ENCE	.861	2.857*WT - .264*HT + 957.13	32.30
WAIST CIR-OMPHAL"N	.893	3.469*WT - .352*HT + 899.02	33.19
WAIST CIR-OMPH/SIT	.866	3.448*WT - .390*HT + 966.50	37.38
BUTTOCK CIRCUMF"CE	.932	2.574*WT - .138*HT + 763.56	20.01
BUTTOCK CIRCUM/SIT	.899	3.059*WT - .179*HT + 863.81	29.40
VERTICAL TRUNK CIR	.857	2.269*WT + .325*HT + 710.83	36.83
VERT TRUNK CIR/SIT	.814	1.910*WT + .377*HT + 613.45	40.34
UPPER THIGH CIRCUM	.897	2.096*WT - .213*HT + 602.85	19.62
UPPER THIGH C/SIT	.914	2.043*WT - .193*HT + 566.47	17.31
KNEE CIRCUMFERENCE	.848	.832*WT - .087*HT + 296.53	10.99
KNEE CIRCUM"CE/SIT	.865	.847*WT - .000*HT + 248.65	11.01
CALF CIRCUMF/RIGHT	.891	.946*WT - .081*HT + 350.66	13.62
ANKLE CIRCUMF"ENCE	.695	.424*WT - .010*HT + 168.00	9.09
SCYE CIRCUMFERENCE	.742	.982*WT - .015*HT + 338.94	18.63
BICEPS C-EXTEND/RT	.856	1.072*WT - .137*HT + 363.85	12.08
BICEPS C-FLEXED/RT	.819	.984*WT - .112*HT + 354.71	12.96
ELBOW CIR-EXTENDED	.786	.556*WT - .021*HT + 218.30	8.86
ELBOW CIRC-FLEXED	.602	.448*WT + .026*HT + 188.63	13.94
LOWER ARM C-FLEXED	.717	.560*WT - .023*HT + 240.41	11.01
WRIST CIRCUMF"ENCE	.589	.239*WT + .009*HT + 117.76	7.46
SLVE L/SPINE-SCYE	.527	.435*WT + .007*HT + 196.61	15.38
SLVE L/SPINE-ELBOW	.701	.383*WT + .206*HT + 173.97	18.66
SLVE L/SPINE-WRIST	.789	.424*WT + .356*HT + 203.17	21.60
SHOULDER LENGTH	.359	.086*WT + .054*HT + 56.24	11.77
INTERSCYE	.414	.812*WT - .072*HT + 374.08	34.25
INTERSCYE MAXIMUM	.685	.968*WT + .059*HT + 360.58	21.97
WAIST FRONT-OMPH"N	.584	.499*WT + .058*HT + 214.11	17.97
CROTCH LGTH-OMPH"N	.725	1.461*WT + .025*HT + 407.28	30.54
WAIST BACK-OMPHL"N	.604	.165*WT + .193*HT + 90.29	18.93
FOOT LENGTH	.693	.092*WT + .114*HT + 51.69	8.57
FOOT BREADTH	.537	.074*WT + .021*HT + 47.40	4.26
BALL-OF-FOOT CIRC	.584	.252*WT + .044*HT + 126.56	10.00
BI-MALLEOLAR BRDTH	.547	.059*WT + .013*HT + 30.26	3.20
LAT"L MALLEOLUS HT	.463	.037*WT + .033*HT + 6.18	4.80
MED"L MALLEOLUS HT	.444	.039*WT + .032*HT + 21.93	5.09
HAND LENGTH	.634	.028*WT + .031*HT + 41.86	6.21
PALM LENGTH	.538	.019*WT + .043*HT + 27.94	4.56
HAND BR/METACARPLE	.494	.052*WT + .016*HT + 49.22	3.61
HAND C/METACARPALE	.539	.178*WT + .031*HT + 130.12	7.90
HAND THICK/META-3	.271	.021*WT + .003*HT + 18.91	2.01
HEAD CIRCUMFERENCE	.423	.236*WT + .026*HT + 489.60	12.92
HEAD LENGTH	.293	.057*WT + .017*HT + 158.61	6.45
HEAD BREADTH	.306	.082*WT - .003*HT + 147.06	5.16

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING MENS ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND SITTING HEIGHT*

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS	SIT HEIGHT IN MM	SE EST
WEIGHT	1.000	1.000*WT +0.000*SIT HT +	0.00	0.00
HEIGHT (STATURE)	.806	.569*WT +1.355*SIT HT +	411.80	36.58
CERVICALE HEIGHT	.763	.671*WT +1.133*SIT HT +	348.48	37.55
ACROMION HEIGHT	.754	.783*WT +1.041*SIT HT +	346.04	37.78
RADIALE HEIGHT	.763	.629*WT + .838*SIT HT +	233.00	29.50
STYLION HEIGHT	.722	.457*WT + .714*SIT HT +	121.48	27.24
DACTYLION HEIGHT	.682	.377*WT + .604*SIT HT +	43.24	25.71
SUPRASTERNALE HGHT	.769	.725*WT +1.034*SIT HT +	362.47	35.13
NIPPLE HEIGHT	.738	.530*WT + .959*SIT HT +	306.62	36.89
WAIST HT-OMPHALION	.806	.438*WT + .726*SIT HT +	312.30	37.47
ILIOCRISTALE HT	.611	.736*WT + .584*SIT HT +	419.26	37.97
BUTTOCK HEIGHT	.635	.612*WT + .453*SIT HT +	373.27	37.04
TROCHANTERION HGHT	.537	.505*WT + .516*SIT HT +	371.56	36.66
GLUTEAL FURROW HGT	.512	.464*WT + .441*SIT HT +	319.82	34.39
CROTCH HEIGHT	.484	.373*WT + .477*SIT HT +	341.94	36.27
PATELLA TOP HEIGHT	.537	.349*WT + .270*SIT HT +	213.57	21.53
KNEE CTR HEIGHT	.544	.350*WT + .263*SIT HT +	190.75	20.86
FIBULAR HEIGHT	.526	.284*WT + .244*SIT HT +	161.65	19.15
CALF HEIGHT	.472	.290*WT + .192*SIT HT +	126.37	19.60
ANKLE HEIGHT	.287	.056*WT + .091*SIT HT +	51.99	11.01
SITTING HEIGHT	1.000	0.000*WT +1.000*SIT HT +	0.00	0.00
EYE HEIGHT/SITTING	.930	-.023*WT + .891*SIT HT -	16.83	11.05
MIDSHOULDER HT/SIT	.877	.178*WT + .695*SIT HT -	32.75	13.19
ACROMION HEIGHT/SIT	.823	.194*WT + .672*SIT HT -	48.87	16.21
ELBOW REST HGT/SIT	.663	.013*WT + .459*SIT HT -	178.64	21.54
KNEE HEIGHT/SITTING	.618	.446*WT + .267*SIT HT +	231.74	19.59
POPLITEAL HGHT/SIT	.492	.183*WT + .311*SIT HT +	129.78	19.50
BUTTOCK-KNEE LNGTH	.646	.728*WT + .109*SIT HT +	376.56	20.58
BUTTOCK-POPLITEAL	.575	.613*WT + .098*SIT HT +	305.82	21.04
SHOULDER-ELBOW LTH	.505	.193*WT + .138*SIT HT +	151.35	14.78
ACROMION-RADIALE L	.479	.192*WT + .170*SIT HT +	137.33	14.92
ELBOW-WRIST LENGTH	.497	.179*WT + .138*SIT HT +	140.71	12.22
RADIALE-STYLION LH	.456	.189*WT + .111*SIT HT +	132.29	12.65
ELBOW-GRIP LENGTH	.512	.188*WT + .177*SIT HT +	154.69	13.87
THUMB-TIP REACH	.485	.527*WT + .356*SIT HT +	379.83	34.77
THUMB-TIP R"CH/XTD	.455	.536*WT + .396*SIT HT +	433.40	40.20
SLEEVE INSEAM	.409	.149*WT + .273*SIT HT +	205.42	23.42
BIACROMIAL BREADTH	.479	.335*WT + .111*SIT HT +	246.22	17.04
BIDELTOID BREADTH	.801	1.011*WT - .087*SIT HT +	388.08	15.32
CHEST BREADTH	.762	.813*WT - .106*SIT HT +	285.03	13.72
WAIST BRDTH-OMPH"N	.873	1.058*WT - .165*SIT HT +	279.19	11.60
HIP BREADTH	.809	.709*WT + .004*SIT HT +	225.53	11.06
HIP BREADTH SITT"G	.557	.954*WT - .053*SIT HT +	261.24	11.84
ELBOW BRDTH BONE/R	.485	.059*WT + .024*SIT HT +	38.08	3.16
F"ARM-F"ARM BR"DTH	.729	1.416*WT - .255*SIT HT +	535.33	25.87
KNEE BR"DTH BONE/R	.555	.110*WT + .031*SIT HT +	51.40	3.40
CHEST DEPTH	.798	.795*WT - .166*SIT HT +	262.34	11.61
WAIST DEPTH-OMPH"N	.802	.918*WT - .209*SIT HT +	260.10	13.02
BUTTOCK DEPTH	.639	.879*WT - .144*SIT HT +	221.72	11.15
THIGH CLEARANCE HT	.793	.554*WT - .081*SIT HT +	144.83	8.40

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING MENS ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND SITTING HEIGHT *

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS	SIT HEIGHT IN MM		SE EST
NECK CIRC -MAXIMUM	.704	.663*WT - .056*SIT HT +	320.86		13.53
SHOULDER CIRCUM"CE	.837	2.392*WT - .205*SIT HT +	953.19		31.80
CHEST CIRCUMF"ENCE	.565	2.824*WT - .529*SIT HT +	988.24		31.86
WAIST CIR-OMPHAL"N	.593	3.391*WT - .659*SIT HT +	901.37		33.23
WAIST CIR-OMPH/SIT	.666	3.360*WT - .726*SIT HT +	966.90		37.46
BUTTOCK CIRCUMF"CE	.826	2.479*WT - .162*SIT HT +	706.76		20.80
BUTTOCK CIRCUM/SIT	.895	2.971*WT - .268*SIT HT +	810.87		29.95
VERTICAL TRUNK CIR	.595	2.148*WT + .892*SIT HT +	476.63		31.92
VERT TRUNK CIR/SIT	.866	1.784*WT +1.013*SIT HT +	359.43		34.76
UPPER THIGH CIRCUM	.877	1.965*WT - .274*SIT HT +	502.40		21.23
UPPER THIGH C/SIT	.899	1.935*WT - .264*SIT HT +	488.63		18.67
KNEE CIRCUMFERENCE	.648	.820*WT + .001*SIT HT +	243.01		11.00
KNEE CIRCUM"CE/SIT	.855	.858*WT - .017*SIT HT +	259.53		11.00
CALF CIRCUMF/RIGHT	.788	.892*WT - .098*SIT HT +	308.36		14.00
ANKLE CIRCUMF"ENCE	.694	.494*WT + .007*SIT HT +	147.03		9.11
SCYE CIRCUMFERENCE	.741	.975*WT - .021*SIT HT +	333.96		18.64
BICEPS C-EXTEND/RT	.823	.993*WT - .167*SIT HT +	293.08		13.26
BICEPS C-FLEXED/RT	.792	.905*WT - .129*SIT HT +	290.20		13.77
ELBOW CIR-EXTENDED	.782	.527*WT - .005*SIT HT +	189.52		8.93
ELBOW CIRC-FLEXED	.799	.466*WT + .031*SIT HT +	202.57		13.98
LOWER ARM C-FLEXED	.714	.534*WT - .011*SIT HT +	215.23		11.07
WRIST CIRCUMF"ENCE	.594	.233*WT + .030*SIT HT +	107.94		7.43
SLVE L/SPINE-SCYE	.529	.420*WT + .029*SIT HT +	183.62		15.37
SLVE L/SPINE-ELBOW	.612	.540*WT + .220*SIT HT +	306.80		20.70
SLVE L/SPINE-WRIST	.642	.720*WT + .344*SIT HT +	462.31		26.96
SHOULDER LENGTH	.331	.112*WT + .079*SIT HT +	73.11		11.89
INTERSCYE	.422	.824*WT - .176*SIT HT +	408.57		34.11
INTERSCYE MAXIMUM	.684	.886*WT + .101*SIT HT +	367.13		22.00
WAIST FRONT-OMPH"N	.633	.436*WT + .221*SIT HT +	122.41		17.13
CROTCH LGTH-OMPH"N	.734	1.373*WT + .196*SIT HT +	294.08		30.12
WAIST BACK-OMPHL"N	.681	.149*WT + .456*SIT HT +	18.18		17.38
FOOT LENGTH	.556	.177*WT + .125*SIT HT +	123.27		9.88
FOOT BREADTH	.494	.082*WT + .034*SIT HT +	51.60		4.30
BALL-OF-FOOT CIRC	.575	.271*WT + .069*SIT HT +	136.77		10.08
BI-MALLEOLAR BRDTH	.536	.065*WT + .031*SIT HT +	32.86		3.23
LAT"L MALLEOLUS HT	.388	.050*WT + .037*SIT HT +	25.21		5.00
MED"L MALLEOLUS HT	.434	.048*WT + .057*SIT HT +	23.99		5.12
HAND LENGTH	.495	.089*WT + .089*SIT HT +	92.60		7.12
PALM LENGTH	.411	.052*WT + .047*SIT HT +	55.85		4.94
HAND BR/METACARPLE	.483	.069*WT + .026*SIT HT +	52.47		3.63
HAND C/METACARPALE	.534	.188*WT + .052*SIT HT +	134.38		7.93
HAND THICK/META-3	.276	.021*WT + .007*SIT HT +	17.87		2.01
HEAD CIRCUMFERENCE	.426	.236*WT + .056*SIT HT +	481.74		12.90
HEAD LENGTH	.296	.059*WT + .034*SIT HT +	157.02		6.44
HEAD BREADTH	.335	.078*WT - .002*SIT HT +	143.96		5.16

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING WOMANS
ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND STATURE *

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS STATURE IN MM	SE EST
WEIGHT	1.000	1.000*WT +0.000*HT + .00	0.00
STATURE	1.000	0.000*WT +1.000*HT - .01	0.00
STATURE, MAXIMUM	.998	.009*WT +1.000*HT + 5.61	3.82
CERVICALE HEIGHT	.977	.094*WT + .834*HT - 53.74	11.65
ACROMIAL HEIGHT	.962	.192*WT + .847*HT - 78.64	15.32
SUPRASTERNALE HGHT	.974	.155*WT + .836*HT - 55.34	12.09
BUST POINT HEIGHT	.928	-.159*WT + .828*HT - 139.10	19.46
WAIST HEIGHT	.914	.038*WT + .679*HT - 102.62	13.29
ABDOMINAL EXT HGT	.899	-.174*WT + .686*HT - 158.93	19.40
TROCHANTERIC HGHT	.852	.023*WT + .602*HT - 152.39	22.35
BUTTOCK HEIGHT	.848	.057*WT + .579*HT - 124.07	22.08
GLUTEAL FURROW HGT	.830	-.246*WT + .581*HT - 182.96	22.10
TIBIALE HEIGHT	.787	-.022*WT + .315*HT - 87.29	14.67
CROTCH HEIGHT	.849	-.373*WT + .581*HT - 166.86	21.25
ANKLE HEIGHT	.336	-.096*WT + .070*HT - .78	12.89
LAT"L MALLEOLUS HT	.426	.010*WT + .040*HT + 1.33	5.31
SITTING HT,RELAXED	.783	.096*WT + .410*HT + 186.51	20.21
SITTING HEIGHT	.803	.147*WT + .401*HT + 187.35	18.88
EYE HEIGHT,SITTING	.740	.142*WT + .355*HT + 144.16	20.57
MIDSHOULDER HT,SIT	.729	.259*WT + .279*HT + 94.66	16.19
WAIST HGHT,SITTING	.452	.249*WT + .080*HT + 72.25	15.47
ELBOW REST HEIGHT	.213	.107*WT + .068*HT + 103.69	24.05
POPLITEAL HEIGHT	.728	-.027*WT + .229*HT + 41.96	12.76
BUTTOCK-POPLIT"L L	.702	.205*WT + .225*HT + 46.89	19.66
BUTTOCK-KNEE LNGTH	.839	.531*WT + .244*HT + 97.77	14.33
ACROMION-RADIALE L	.728	.076*WT + .185*HT + .36	11.15
RADIALE-STYLION L	.656	.024*WT + .143*HT - 9.36	10.20
THUMB-TIP REACH	.655	.289*WT + .375*HT + 97.05	29.30
THUMB-TIP,EXTENDED	.622	.396*WT + .439*HT + 76.94	38.19
OVERHEAD REACH	.857	.225*WT +1.181*HT + 48.59	44.69
NECK CIRCUMFERENCE	.582	.582*WT + .003*HT + 257.91	13.63
SHOULDER CIRCUMFER	.645	2.843*WT - .133*HT + 857.47	27.46
CHEST CIRC AT SCYE	.819	2.706*WT - .157*HT + 752.50	28.47
BUST CIRCUMFERENCE	.824	3.179*WT - .224*HT + 855.65	32.33
CHEST C BELOW BUST	.806	2.608*WT - .150*HT + 654.74	28.83
WAIST CIRCUMFERNCE	.848	3.116*WT - .204*HT + 606.52	29.21
ABDOMINAL EXT CIRC	.821	4.064*WT - .301*HT + 826.51	41.55
HIP C-7""BLW WAIST	.903	3.304*WT - .156*HT + 768.46	24.02
HIP C-9""BLW WAIST	.895	3.513*WT - .156*HT + 758.36	26.81
UPPER THIGH CIRCUM	.867	2.481*WT - .178*HT + 527.67	21.00
KNEE CIRCUMFERENCE	.822	1.170*WT - .026*HT + 256.69	12.92
CALF CIRCUM, RIGHT	.763	1.125*WT - .055*HT + 287.29	14.53
ANKLE CIRCUMFERNCE	.593	.437*WT + .012*HT + 136.18	10.38
VERTICAL TRUNK CIR	.822	2.648*WT + .319*HT + 691.15	39.15
VERTICAL TRK C,SIT	.811	2.072*WT + .436*HT + 529.70	38.36
BUTTOCK CIRC, SIT	.912	3.534*WT - .143*HT + 774.24	25.00
SCYE CIRCUMFERENCE	.778	1.121*WT - .026*HT + 270.36	14.37
AXILLARY ARM CIRC	.850	1.390*WT - .140*HT + 325.20	12.32
BICEPS C,RELAXED,R	.871	1.404*WT - .153*HT + 324.94	11.26
BICEPS C,FLEXED, R	.865	1.400*WT - .143*HT + 321.98	11.63

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING WOMAN'S ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND STATURE*

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS	STATURE IN MM		SE EST
ELBOW CIRC, FLEXED	.586	.530*WT +	.044*HT +	130.69	14.45
FOREARM C, RELAXED	.323	.746*WT -	.039*HT +	202.84	7.68
FOREARM C, FLEXED	.790	.787*WT -	.038*HT +	211.29	9.32
WRIST CIRCUMFERENCE	.658	.242*WT +	.016*HT +	89.47	5.36
BIACROMIAL BREADTH	.545	.348*WT +	.073*HT +	195.13	13.75
BIDELTOID BREADTH	.811	1.241*WT -	.056*HT +	368.33	13.53
CHEST BREADTH	.716	.590*WT -	.042*HT +	235.07	13.49
BUST PT-BUST PT BR	.598	.617*WT -	.036*HT +	165.86	12.40
WAIST BREADTH	.773	.989*WT -	.036*HT +	176.76	12.27
HIP BREADTH	.774	1.091*WT -	.032*HT +	262.60	14.04
THIGH-THIGH BR,SIT	.811	1.577*WT -	.118*HT +	372.40	16.74
HUMERAL BREADTH, B	.588	.072*WT +	.014*HT +	29.05	2.48
FEMORAL BREADTH, B	.496	.116*WT +	.009*HT +	52.93	3.92
CHEST DEPTH	.770	1.013*WT -	.076*HT +	230.77	12.32
WAIST DEPTH	.773	.392*WT -	.078*HT +	102.45	10.60
ABDOMINAL EXT DPTH	.850	1.213*WT -	.105*HT +	224.95	11.81
BUTTOCK DEPTH	.836	1.021*WT -	.079*HT +	210.19	9.83
THIGH CLEARANCE	.715	.510*WT +	.015*HT +	35.29	8.74
SHOULDER LENGTH	.377	.068*WT +	.052*HT +	53.35	9.46
NECK-BUST POINT L	.574	.636*WT -	.018*HT +	196.12	15.47
STRAP LENGTH	.535	1.592*WT -	.023*HT +	486.61	29.64
INTERSCYE	.548	.891*WT -	.055*HT +	325.79	20.44
INTERSCYE, MAXIMUM	.557	1.011*WT +	.044*HT +	294.19	27.30
BACK CURVATURE	.615	1.235*WT -	.062*HT +	364.41	24.07
WAIST BACK	.536	-.025*WT +	.220*HT +	52.11	17.96
ANTERIOR WAIST LTH	.523	.354*WT +	.097*HT +	133.48	16.67
SLEEVE INSEAM	.715	-.180*WT +	.311*HT -	40.05	15.88
SPINE-TO-SCYE LGTH	.431	.333*WT +	.010*HT +	145.78	12.24
SPINE-TO-ELBOW LTH	.722	.419*WT +	.211*HT +	138.48	16.65
SPINE-TO-WRIST LTH	.782	.454*WT +	.352*HT +	167.20	20.69
HAND LENGTH	.606	.051*WT +	.089*HT +	33.77	7.63
HAND BREADTH	.457	.070*WT +	.014*HT +	43.46	3.46
HAND CIRCUMFERENCE	.509	.230*WT +	.021*HT +	119.37	7.81
FOOT LENGTH	.712	.135*WT +	.110*HT +	45.06	7.92
FOOT BREADTH	.429	.065*WT +	.017*HT +	50.38	4.50
HEAD LENGTH	.396	.077*WT +	.025*HT +	134.28	6.35
HEAD BREADTH	.290	.109*WT -	.003*HT +	135.41	5.69
HEAD CIRCUMFERENCE	.426	.310*WT +	.044*HT +	438.21	14.69

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION

VARIABLE	R	WEIGHT IN LBS SIT HEIGHT IN MM					SE EST
WEIGHT	1.000	1.000*WT	+0.000*SIT	HT	+	.00	0.00
STATURE	.818	.693*WT	+1.342*SIT	HT	+	383.91	34.54
STATURE, MAXIMUM	.820	.693*WT	+1.351*SIT	HT	+	382.60	34.46
CERVICALE HEIGHT	.788	.772*WT	+1.117*SIT	HT	+	337.97	34.56
ACROMIAL HEIGHT	.765	.865*WT	+1.043*SIT	HT	+	315.68	35.32
SUPRASTERNALE HGHT	.776	.810*WT	+1.040*SIT	HT	+	326.38	33.42
BUST POINT HEIGHT	.690	.544*WT	+ .971*SIT	HT	+	262.89	37.72
WAIST HEIGHT	.653	.721*WT	+ .680*SIT	HT	+	329.02	34.18
ABDOMINAL EXT HGT	.589	.562*WT	+ .639*SIT	HT	+	313.10	35.75
TROCHANTERIC HGHT	.553	.724*WT	+ .500*SIT	HT	+	306.73	35.26
BUTTOCK HEIGHT	.552	.770*WT	+ .439*SIT	HT	+	348.28	34.72
GLUTEAL FURROW HGT	.477	.471*WT	+ .437*SIT	HT	+	292.67	34.81
TIBIALE HEIGHT	.502	.354*WT	+ .250*SIT	HT	+	160.52	20.55
CROTCH HEIGHT	.523	.650*WT	+ .430*SIT	HT	+	294.03	34.35
ANKLE HEIGHT	.220	.060*WT	+ .075*SIT	HT	+	40.25	13.21
LAT'L MALLEOLUS HT	.347	.040*WT	+ .051*SIT	HT	+	18.59	5.51
SITTING HT,RELAXED	.968	-.037*WT	+1.003*SIT	HT	-	10.81	8.13
SITTING HEIGHT	1.000	0.000*WT	+1.000*SIT	HT	-	.00	0.00
EYE HEIGHT,SITTING	.928	.003*WT	+ .894*SIT	HT	-	28.89	11.43
MIDSHOULDER HT,SIT	.885	.153*WT	+ .701*SIT	HT	-	39.15	12.38
WAIST HGHT,SITTING	.573	.101*WT	+ .264*SIT	HT	-	12.67	14.21
ELBOW REST HEIGHT	.558	-.197*WT	+ .473*SIT	HT	-	153.02	20.43
POPLITEAL HEIGHT	.447	.260*WT	+ .168*SIT	HT	+	233.36	16.64
BUTTOCK-POPLIT'L L	.568	.388*WT	+ .056*SIT	HT	+	316.17	22.71
BUTTOCK-KNEE LNGTH	.733	1.006*WT	+ .105*SIT	HT	+	356.71	18.74
ACROMION-RADIALE L	.517	.287*WT	+ .158*SIT	HT	+	138.32	13.91
RADIALE-STYLION L	.438	.208*WT	+ .111*SIT	HT	+	112.36	12.30
THUMB-TIP REACH	.481	.740*WT	+ .294*SIT	HT	+	395.02	33.98
THUMB-TIP,EXTENDED	.489	.843*WT	+ .433*SIT	HT	+	360.50	42.56
OVERHEAD REACH	.652	1.267*WT	+1.343*SIT	HT	+	681.62	64.89
NECK CIRCUMFERENCE	.584	.559*WT	+ .031*SIT	HT	+	239.48	13.61
SHOULDER CIRCUMFER	.841	2.761*WT	- .190*SIT	HT	+	815.06	27.78
CHEST CIRC AT SCYE	.812	2.600*WT	- .214*SIT	HT	+	694.63	28.97
BUST CIRCUMFERENCE	.816	3.062*WT	- .342*SIT	HT	+	800.30	32.93
CHEST C BELOW BUST	.802	2.535*WT	- .235*SIT	HT	+	621.70	29.10
WAIST CIRCUMFERNCE	.845	3.055*WT	- .362*SIT	HT	+	592.98	29.32
ABDOMINAL EXT CIRC	.809	3.858*WT	- .406*SIT	HT	+	713.13	42.80
HIP C-3""BLW WAIST	.897	3.181*WT	- .194*SIT	HT	+	697.14	24.71
HIP C-9""BLW WAIST	.887	3.311*WT	- .108*SIT	HT	+	623.65	27.79
UPPER THIGH CIRCUM	.855	2.354*WT	- .235*SIT	HT	+	456.66	21.91
KNEE CIRCUMFERENCE	.820	1.144*WT	- .027*SIT	HT	+	240.37	12.96
CALF CIRCUM, RIGHT	.755	1.062*WT	- .046*SIT	HT	+	246.03	14.74
ANKLE CIRCUMFERNCE	.601	.414*WT	+ .043*SIT	HT	+	116.22	10.31
VERTICAL TRUNK CIR	.871	2.411*WT	+ .924*SIT	HT	+	446.66	33.71
VERTICAL TRK C,SIT	.876	1.885*WT	+1.118*SIT	HT	+	303.93	31.61
BUTTOCK CIRC, SIT	.906	3.434*WT	- .125*SIT	HT	+	670.31	25.80
SCYE CIRCUMFERENCE	.777	1.102*WT	- .033*SIT	HT	+	259.24	14.40
AXILLARY ARM CIRC	.820	1.279*WT	- .174*SIT	HT	+	260.72	13.39
BICEPS C,RELAXED,R	.836	1.293*WT	- .199*SIT	HT	+	262.04	12.51
BICEPS C,FLEXED, R	.838	1.301*WT	- .192*SIT	HT	+	266.48	12.65

* Weight in pounds. All other values in millimeters.

MULTIPLE REGRESSION EQUATION FOR PREDICTING WOMANS ANTHROPOMETRIC DIMENSIONS FROM BODY WEIGHT AND SITTING HEIGHT *

VARIABLE	R	MULTIPLE REGRESSION EQUATION WEIGHT IN LBS	SIT HEIGHT IN MM	SE EST
ELBOW CIRC, FLEXED	.675	.579*WT + .039*SIT HT +	162.45	14.58
FOREARM C, RELAXED	.814	.719*WT - .051*SIT HT +	187.35	8.00
FOREARM C, FLEXED	.785	.762*WT - .053*SIT HT +	197.73	9.41
WRIST CIRCUMFERNCE	.639	.248*WT + .034*SIT HT +	89.24	5.35
BIACROMIAL BREADTH	.522	.399*WT + .098*SIT HT +	223.47	13.98
BIDELTOID BREADTH	.805	1.196*WT - .091*SIT HT +	343.98	13.71
CHEST BREADTH	.704	.852*WT - .047*SIT HT +	211.98	13.59
BUST PT-BUST PT BR	.680	.614*WT - .073*SIT HT +	169.58	12.38
WAIST BREADTH	.775	.963*WT - .073*SIT HT +	181.32	12.24
HIP BREADTH	.770	1.022*WT + .008*SIT HT +	213.05	14.13
THIGH-THIGH BR,SIT	.787	1.424*WT - .080*SIT HT +	269.31	17.65
HUMERAL BREADTH, R	.577	.079*WT + .023*SIT HT +	31.80	2.51
FEMORAL BREADTH, R	.495	.119*WT + .015*SIT HT +	53.50	3.92
CHEST DEPTH	.767	.986*WT - .130*SIT HT +	222.24	12.39
WAIST DEPTH	.763	.856*WT - .124*SIT HT +	167.17	10.73
ABDOMINAL EXT DPTH	.825	1.174*WT - .173*SIT HT +	211.46	11.99
BUTTOCK DEPTH	.825	.977*WT - .118*SIT HT +	166.19	10.10
THIGH CLEARANCE	.714	.550*WT - .012*SIT HT +	64.74	8.77
SHOULDER LENGTH	.338	.101*WT + .073*SIT HT +	71.16	9.61
NECK-BUST POINT L	.573	.640*WT + .013*SIT HT +	162.00	15.49
STRAP LENGTH	.656	1.486*WT + .068*SIT HT +	404.74	29.60
INTERSCYE	.539	.844*WT - .063*SIT HT +	297.23	20.55
INTERSCYE, MAXIMUM	.556	1.029*WT + .072*SIT HT +	301.05	27.32
BACK CURVATURE	.610	1.187*WT - .077*SIT HT +	336.39	24.18
WAIST BACK	.657	-.031*WT + .467*SIT HT +	9.05	16.70
ANTERIOR WAIST LTH	.579	.312*WT + .249*SIT HT +	82.72	15.95
SLEEVE INSEAM	.405	.192*WT + .248*SIT HT +	204.69	22.08
SPINE-TO-SCYE LGTH	.432	.332*WT + .021*SIT HT +	143.23	12.24
SPINE-TO-ELBOW LTH	.624	.621*WT + .222*SIT HT +	263.87	18.80
SPINE-TO-WRIST LTH	.623	.848*WT + .311*SIT HT +	421.49	25.95
HAND LENGTH	.464	.138*WT + .091*SIT HT +	88.67	8.49
HAND BREADTH	.439	.080*WT + .019*SIT HT +	49.03	3.50
HAND CIRCUMFERENCE	.503	.243*WT + .030*SIT HT +	126.58	7.84
FOOT LENGTH	.592	.235*WT + .122*SIT HT +	106.42	9.09
FOOT BREADTH	.404	.102*WT + .017*SIT HT +	61.32	4.55
HEAD LENGTH	.337	.091*WT + .036*SIT HT +	141.82	6.39
HEAD BREADTH	.290	.105*WT - .001*SIT HT +	132.62	5.69
HEAD CIRCUMFERENCE	.419	.333*WT + .067*SIT HT +	448.97	14.74

* Weight in pounds. All other values in millimeters.

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